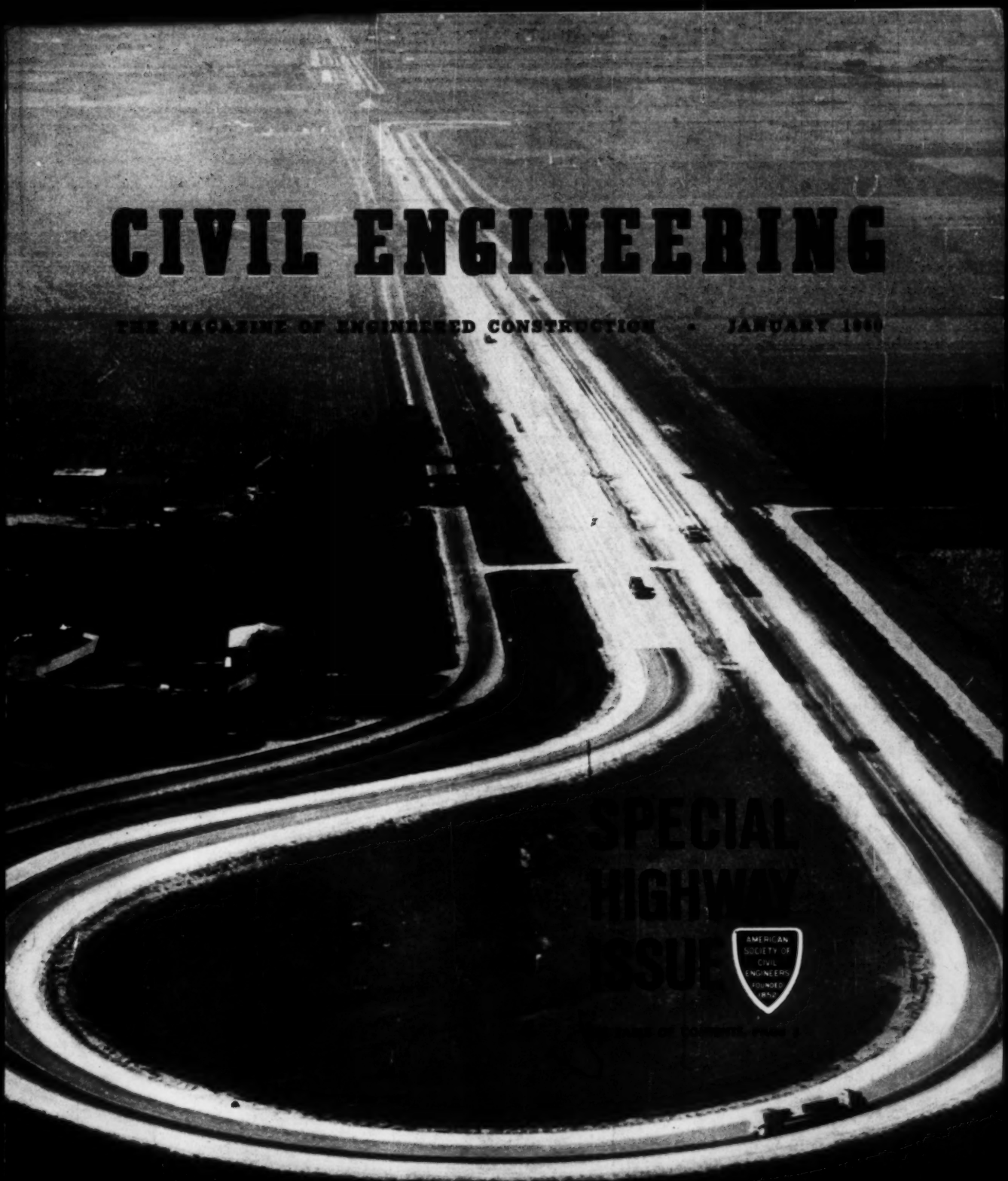

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THE MAGAZINE OF ENGINEERED CONSTRUCTION • JANUARY 1960

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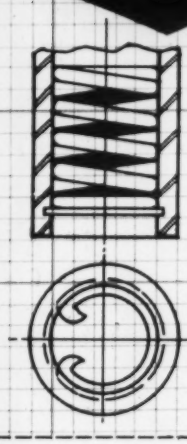

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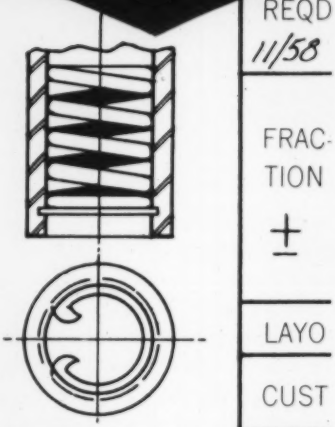

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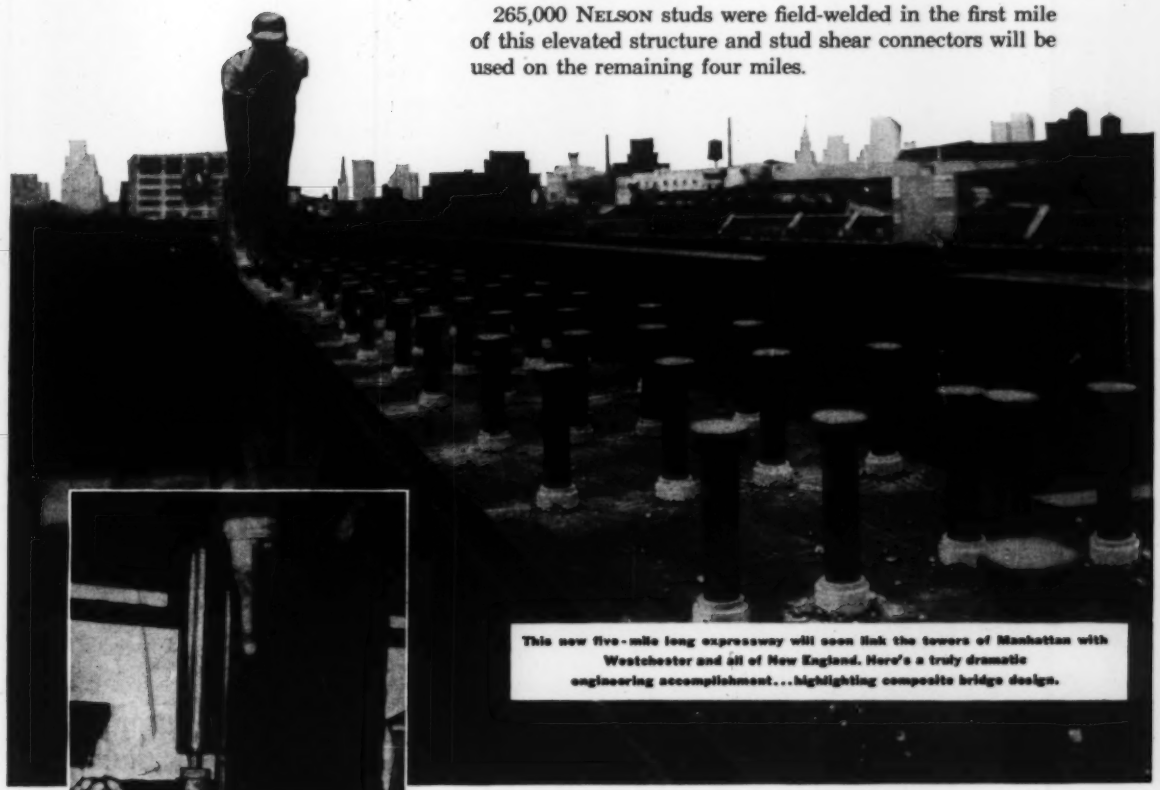

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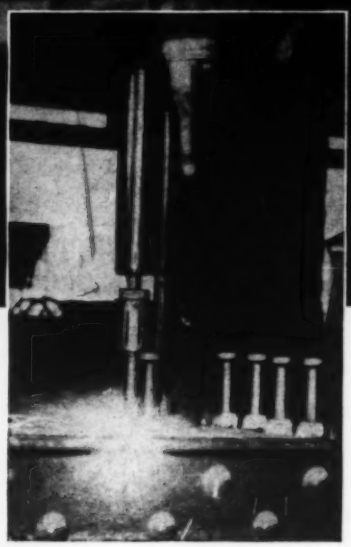

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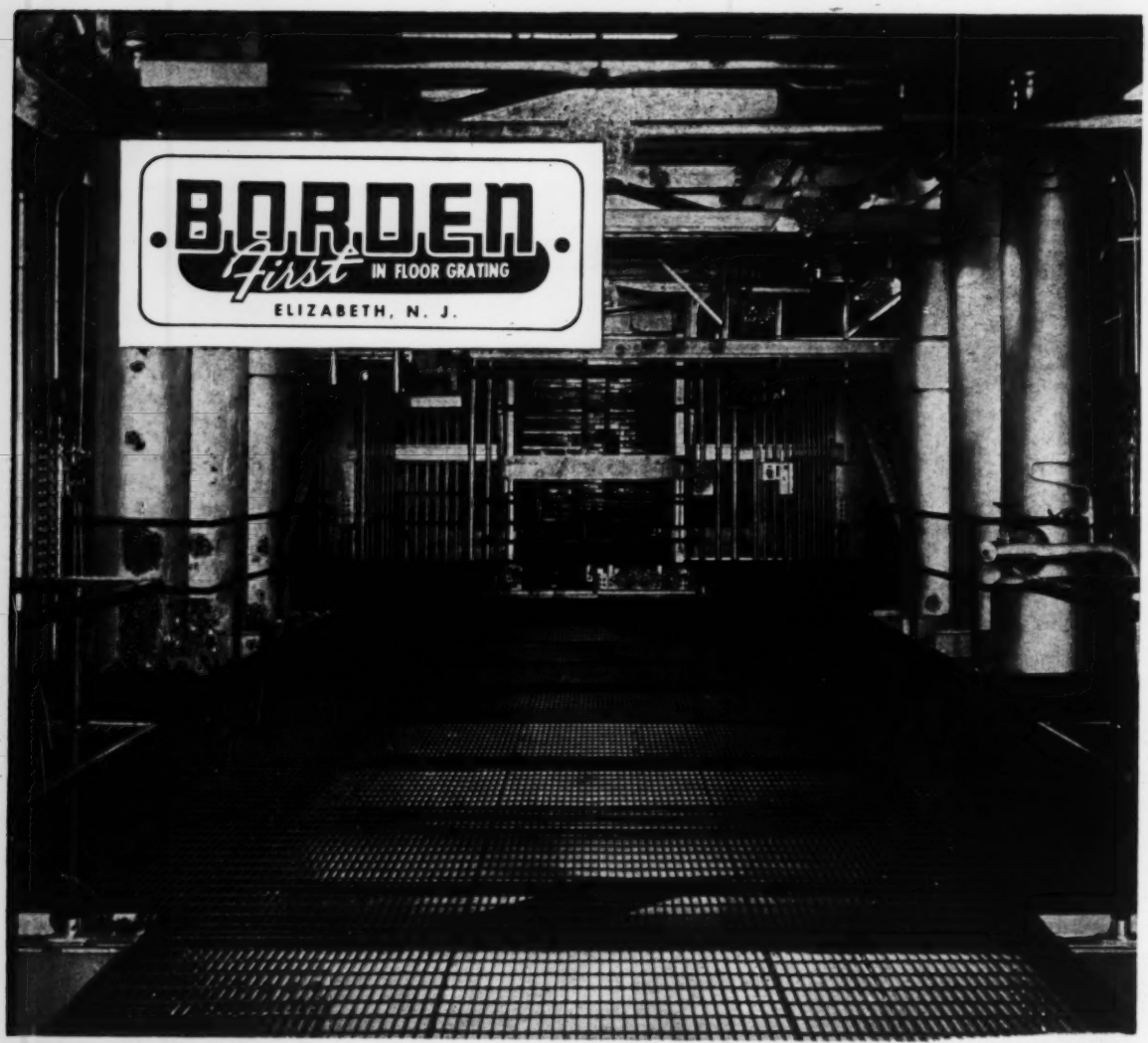

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CIVIL ENGINEERING

JANUARY 1960
VOL. 30 • NO. 1

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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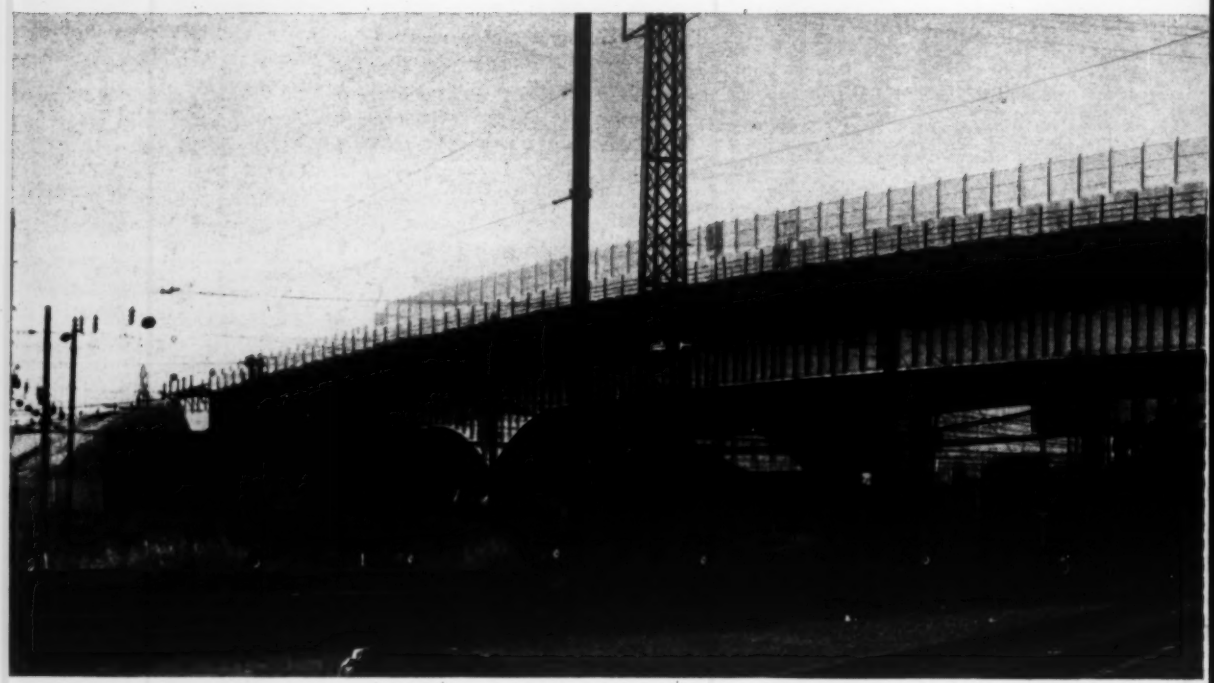
Featuring a 378′9″ span, this highway bridge constructed for the Connecticut State Highway Department in New Haven carries Route 34 over the NYNH&H Railroad tracks to a connection with the Connecticut Turnpike. It was designed by Dr. David B. Steinman and constructed by American Bridge—the same team that built the Mackinac Bridge. ☐ The bridge created a tricky design problem because it had to cross an electrified line and railroad terminal yard. At first shorter spans utilizing a center pier were considered but then abandoned as too costly since relocation of tracks and control devices in an automatically controlled yard would have been required. ☐ Three types of bridge structures were then considered: a through-truss, a plate girder and box-girder. A through-truss would have required a main span of 440 feet. A plate girder design using 4 girders would have cut the span to 410 feet. The box-girder design was selected because it reduced the length of the span to less than 380 feet. The bridge consists



of three continuous box-girder spans of 151′6″, 378′9″ and 151′6″, and carries two 53′ four-lane roadways. ☐ The bridge also created fabrication, transporation and construction problems because mammoth individual sections had to be handled, and because main line rail traffic could not be interrupted. But the job was completed on schedule, without stopping a train. Just another case where steel provided a practical and economical solution to a difficult design and construction problem. ☐ For more information on our services, write, or call our sales office near you.

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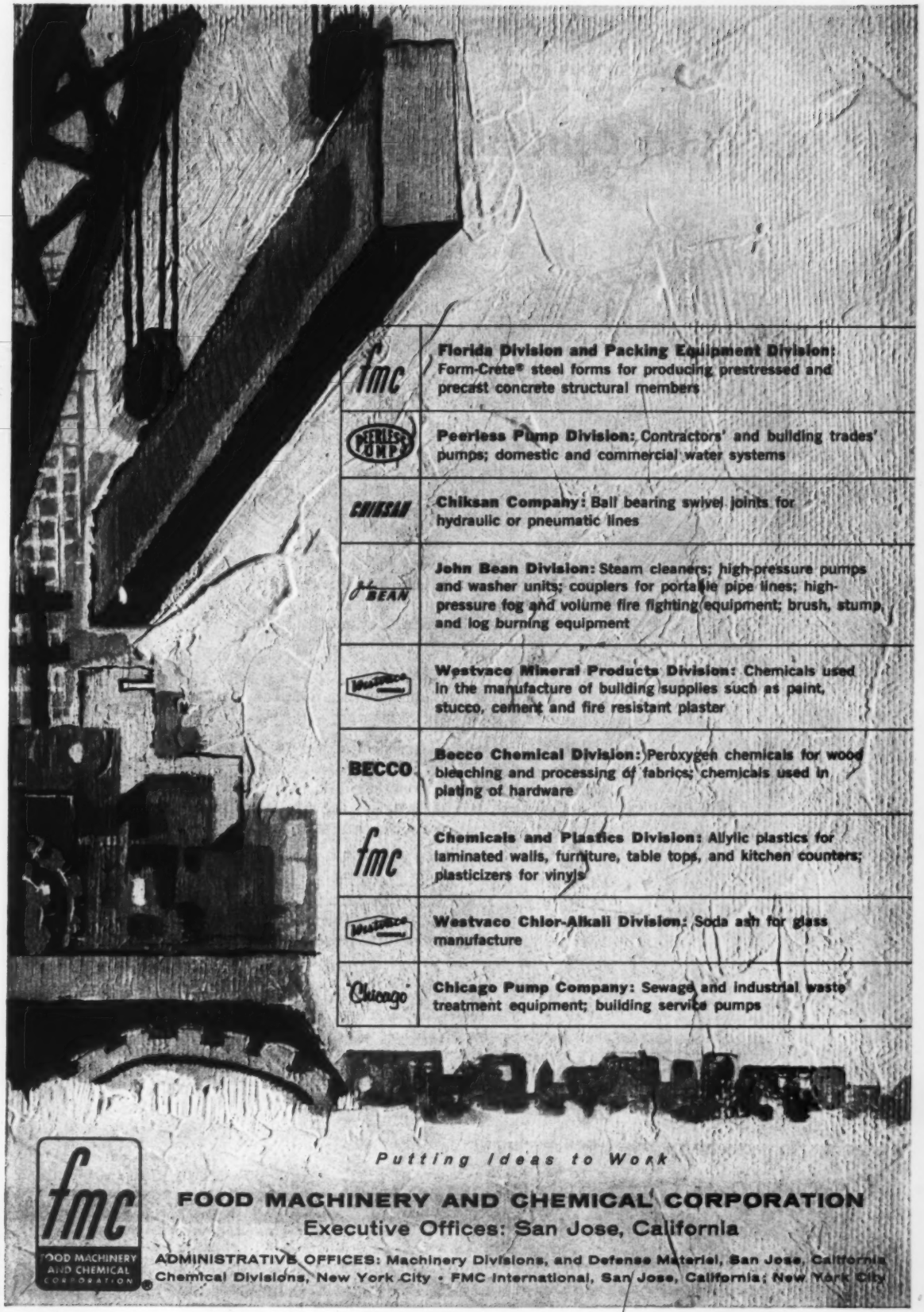
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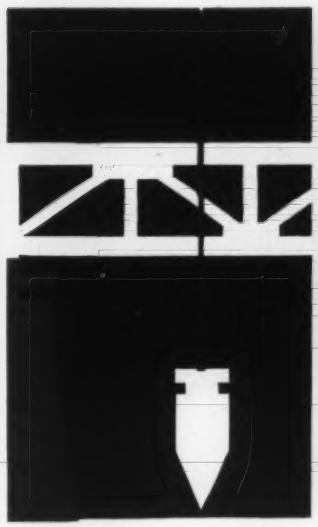

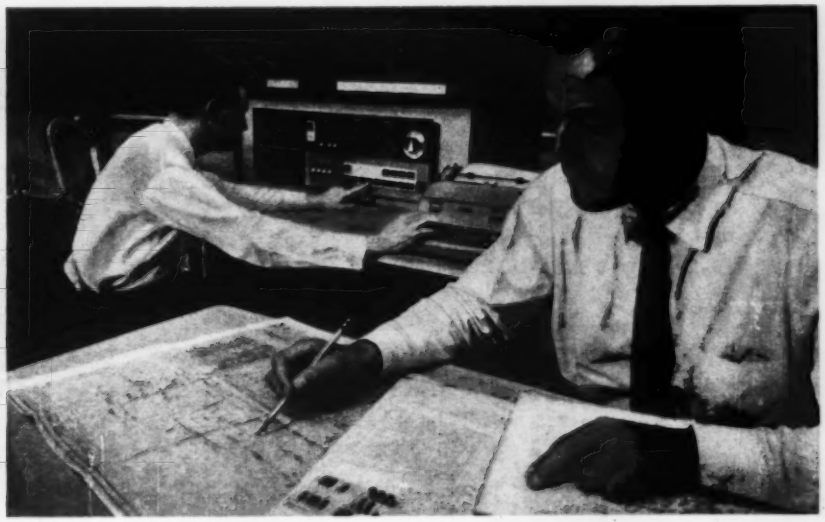

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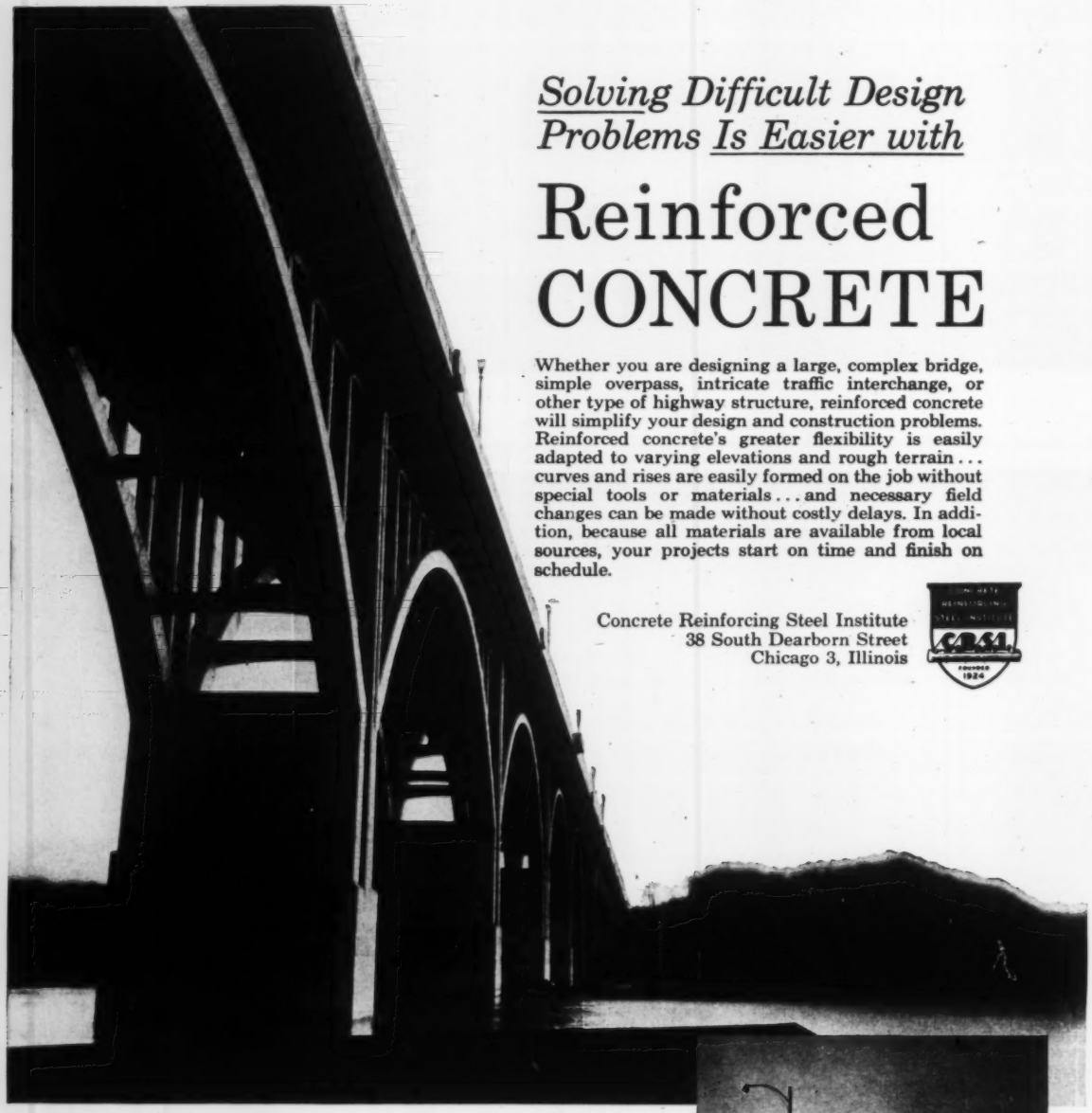

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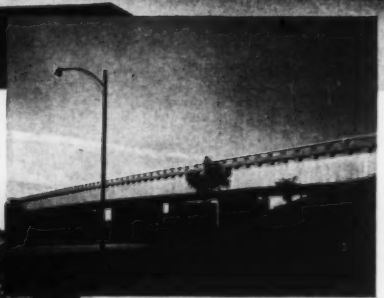
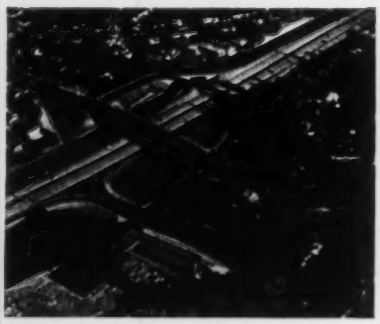
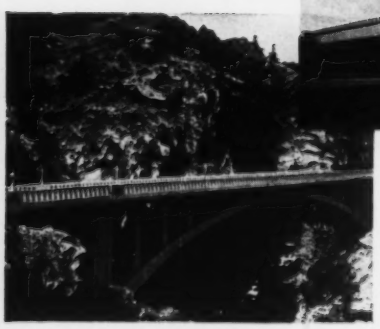


Overpass along Edens Expressway, Chicago, Illinois



Sunset Boulevard Interchange, Los Angeles, California



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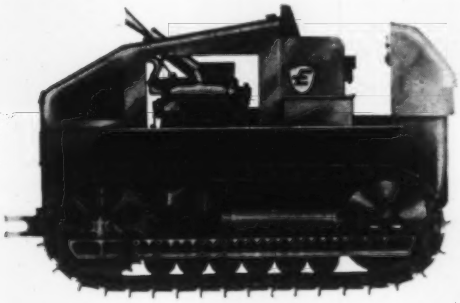

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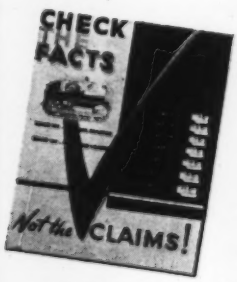

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Smooth, clean surface-textures and good density with no cracks were readily obtained with POZZOLITH—as were the high early flexural strengths needed for tilt-up construction. Construction costs of Grace Church ($12 per square foot) demonstrated the economy of architectural concrete.

To better meet concreting requirements on your projects—call in the local Master Builders field man. He'll demonstrate how concrete produced with POZZOLITH becomes a more versatile and more useful building material . . . superior in performance, in quality and in economy to plain concrete or concrete produced with any other admixture.

The Master Builders Company, Cleveland, Ohio
Division of American-Marietta Company
The Master Builders Company, Ltd., Toronto, Ontario
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Master Builders International, Nassau, Bahamas
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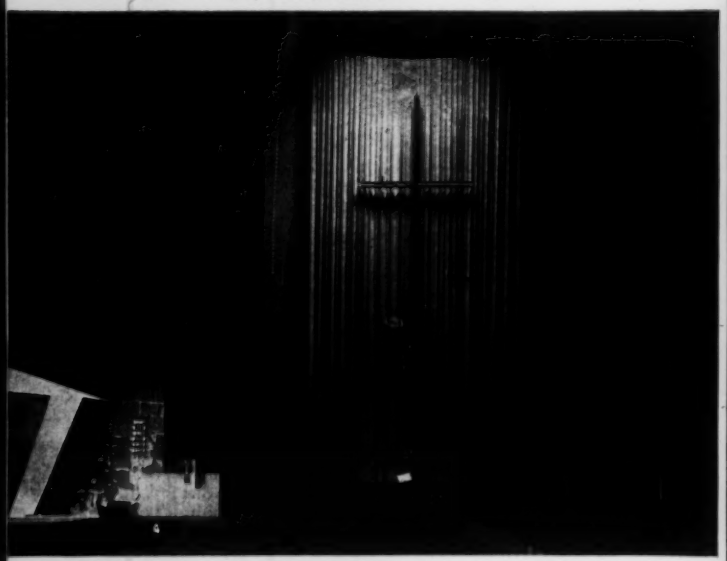
Branch Offices in all principal cities.



SPACE AND LIGHT... are subtly balanced to achieve a spiritual atmosphere. The exposed concrete interior provides both excellent acoustics and appearance. The church seats 600.

MASTER BUILDERS®
POZZOLITH®

•POZZOLITH is a registered trademark of The Master Builders Co. for its concrete admixture to reduce water and control entrainment of air and rate of hardening.

GRACE LUTHERAN CHURCH . . . recently completed $110,000 contemporary church —part of a $350,000 church-and-school building program. Architects: Baume and Polivnick, A.I.A. • Consulting Engineer: Ketchum and Konkel • General Contractor: Lippert Brothers • POZZOLITH Ready-Mixed Concrete: Ready-Mixed Concrete Co. of Denver — all of Denver, Colorado.

IF YOUR DECISION MUST STAND UP FOR 100 YEARS

If your decision today will in some way determine your town's water supply system for the next century, consider the case for cast iron pipe:

- Cast iron pipe is built to *last*—96 American cities will testify to that. They've had cast iron pipe installations in constant use for over a century! And in Versailles, France, they're still using cast iron pipe water mains that were laid in 1664! Solid proof that once cast iron pipe is in the ground, it stays there!
- Cast iron pipe rarely requires repair. Its rugged construction, corrosion-resistant qualities and bottle-tight, rubber-ring joints will withstand the most severe pressures. Once an investment is made in cast iron pipe, it is usually your first and last cost because of the absence of maintenance or repairs.

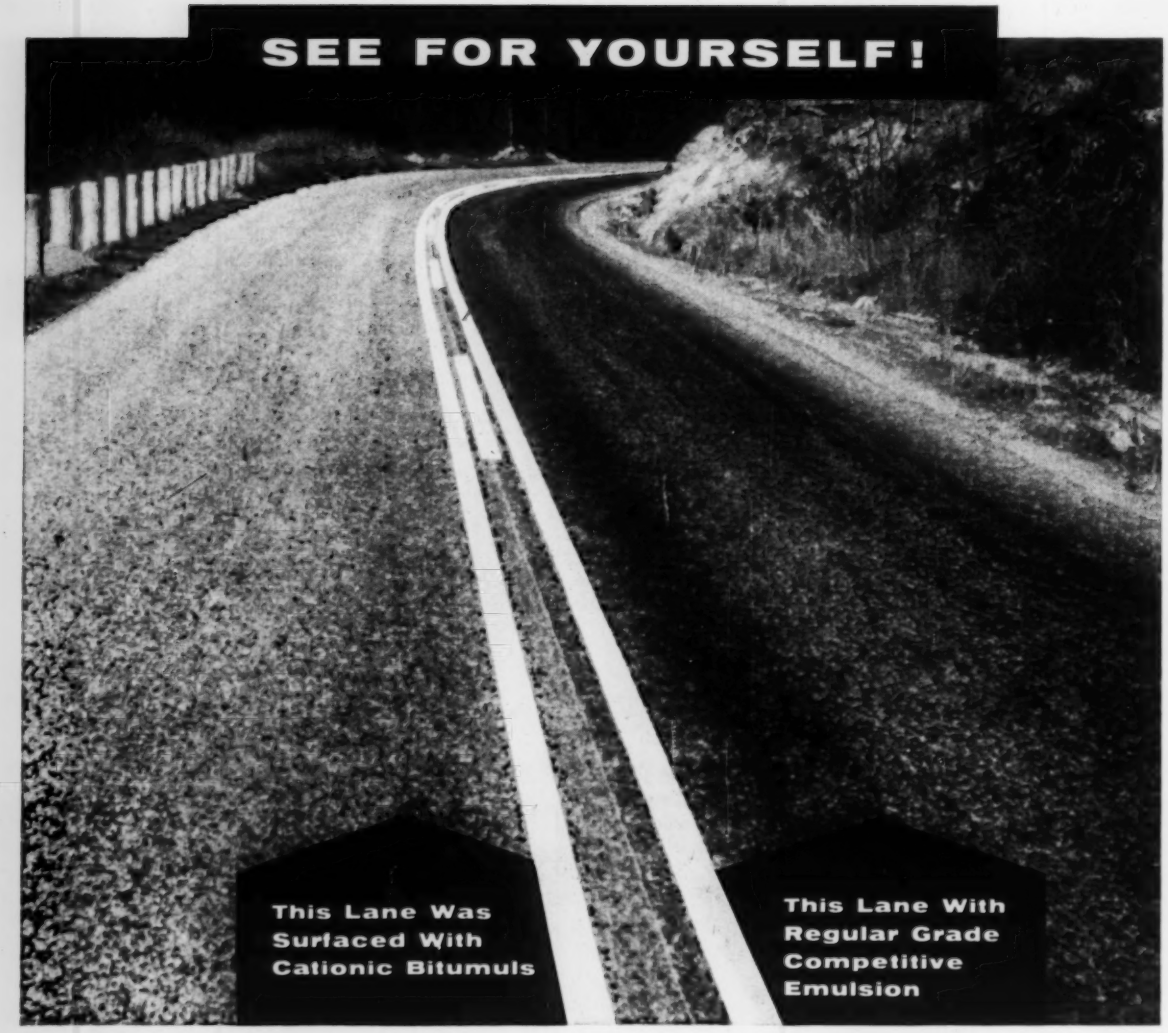
Don't be fooled by initial pipe costs. You can't save money on "low-cost" pipe if you have to repair and replace it frequently. Insist on the pipe that will actually save you money over a period of years—cast iron pipe!

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois

Rely on

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE



You Get BETTER Surface Treatments With CATIONIC BITUMULS

This photograph gives visible proof of the superior performance of Cationic Bitumuls. The picture was taken on a 25-mile test section of highway in North Carolina.

Based on the success of this job, Cationic Bitumuls is being used for extensive surface treatment work throughout the State during the current construction season.

In every test made to date—whether in laboratory or field—Cationic Bitumuls has shown two outstanding qualities:

1. Unusual ability to hold aggregate, even "difficult" types.
2. Rapid initial set that minimizes damage from early rainfall.

If you haven't tried this new material, call our nearest office today and arrange to test Cationic Bitumuls on your next pavement construction or maintenance job.

American Bitumuls & Asphalt Company

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St. Louis 17, Mo. Inglewood, Calif. Cincinnati 38, Ohio Tucson, Ariz. San Juan 23, Puerto Rico

BITUMULS® Emulsified Asphalts • CHEVRON® Paving Asphalts • LAYKOLD® Asphalt Specialties • PETROLASTIC® Industrial Asphalts

Aerial view of intake construction area of Niagara Power Project, being built under the direction of the Power Authority of the State of New York. Contractor for the intake portion is Merritt-Chapman & Scott Corp.

Steel Cofferdam for Intakes of Niagara Power Project

Located three miles above the Falls, the Niagara Power Project intake facilities consist of two wide-mouth, harmonica-type structures 840 ft long. The water, some 50,000 cu ft per second, will flow through the intake, conduits, and canal to the new generating plant. Flow into the intake and conduits will be controlled by vertical-lift gates.

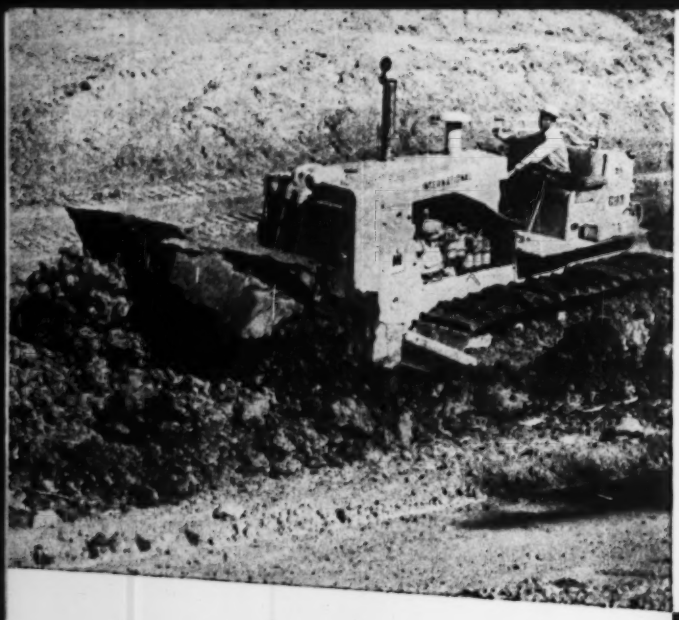
Other phases of intake construction required the relocating of water lines to six existing companies, extensive river bottom excavation, and an upstream wall 500 ft long to guide water to the intake.

Bethlehem supplied 5,500 tons of steel sheet piling for the cofferdams which were built into the river, surrounding the construction area.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Distributor: Bethlehem Steel Export Corporation*

BETHLEHEM STEEL

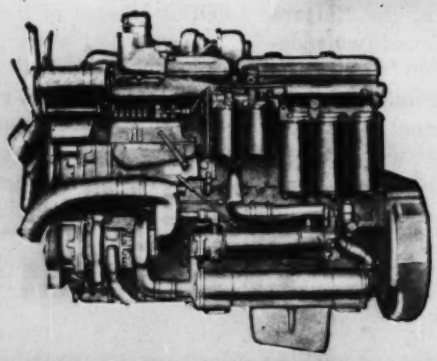
BETHLEHEM STEEL



Keep full loads on the move full time with exclusive Planet Power-steering. Full power on both tracks, *full time*, is the answer! And Hi-Lo on-the-go power-shifting lets you match power to condition, instantly, and keep the yard-boosting advantage of uninterrupted momentum.

You speed-up all four steps of the push-loading cycle with TD-25 torque-converter and planetary system teamwork! 1) You slow down by power-shifting down and using decelerator to get feather-touch contact; 2) power-shift either track up or down to maintain solid pusher contact on curves; 3) get gear-higher kick-outs, with on-the-go power-shifting; 4) reposition faster, with higher-than-ordinary reverse! Two "25s" tandem-pushing the International 295 Payscraper®, and the third, scarifying, belong to contractor Ed Bentley, Sylacauga, Alabama — building superhighway near Birmingham.

PLANET Power-steering... HI-LO power-shifting... COME AS standard equipment ONLY in the new TD-25



The International DT-817 engine—single power source used in both *pushers* and *scrapers*—an *industry first* in power standardization. You'll find this big new direct-start, 6-cylinder turbocharged diesel powering the full line of International two and three-axle Payscrapers; Paywagons®; and end-dump Payhaulers.® *Plus* the new TD-25! Dual valving of this high-torque, 230-hp power plant provides for peak turbocharging efficiency, to develop full power from sea level to timberline!

As standard equipment at no extra cost, the new 230-hp TD-25 gives you the International®-proven control combination that has been beating king-sized clutch-steered crawlers in yardage for years!

You get combined Planet Power-steering and Hi-Lo on-the-go, power-shifting exclusively in the new International TD-25. And you get this basic, built-in design advantage in your choice of torque-converter or synchromesh model!

With this and all its other big advantages, the TD-25 can outearn other big rigs up to 50%—on push-loading; and pulling big drawbar tools such as shale-shattering scarifers!

No "dead-track drag" or "gear-shift lag"! Planet Power-steering gives you full-time "live" power and traction on both tracks, to make full-load turns—and to eliminate load-limiting "dead-track drag." And Hi-Lo on-the-go power-shifting instantly matches power to conditions to prevent load-losing "gear-shift lag."

Hi-Lo power-shifting makes the TD-25 the industry's only 4-speed torque-converter crawler and the only one with load-matching efficiency-range control. In the synchromesh transmission "25," the Hi-Lo planetary system gives eight speeds forward and reverse—with cycle-speeding, up-or-down, on-the-go power-shifting with "finger-tip" ease!

Power-shift and power-steer the new "25" with full king-size loads—around curves, upgrade, anywhere. Prove what it means to command full-time, full-load ability to outearn clutch-steered king-sized crawlers, up to 50%. Measure all the "25's" standard equipment extra value features! See your International Construction Equipment Distributor for a demonstration!

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A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors... Self-Propelled Scrapers and Bottom-Dump Wagons... Crawler and Rubber-Tired Loaders... Off-Highway Haulers... Diesel and Carbureted Engines... Motor Trucks... Farm Tractors and Equipment.

International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill.

NEWS OF MEMBERS

Henry M. Shank, chief of the Division of Engineering of the U. S. Forest Service Regional Office at Denver, Colo., is retiring on December 31. Mr. Shank started his career with the Forest Service in 1921. During his years in the Denver regional office, 700 miles of forest development roads and 165 bridges were constructed or reconstructed.

Burt L. Knowles, widely known in the construction industry, has retired after twenty-five years of service with the Associated General Contractors, Washington, D. C. He will continue to work as a consultant and will handle special assignments for AGC. Mr. Knowles joined the AGC staff in 1934 and has since served as AGC national director, as a member of the Executive Committee, and on various other committees.

G. J. Currie has been appointed assistant chief engineer of the Nova Scotia Light and Power Company, Ltd., and subsidiary companies. A member of the company's engineering staff at Halifax since 1931, he was made senior civil and hydraulic engineer in 1950.

V. B. Bandjunis, until recently public works officer with the U.S. Navy at Chelsea, Mass., has joined the staff of the Benjamin E. Beavin Company, consulting engineers of Baltimore. As public works officer he was in charge of all engineering work at the U.S. Naval Hospital at Chelsea.

Hollis A. Hunt, project manager of the Lahontan Basin Project, U. S. Bureau of Reclamation, has been transferred and promoted to chief of irrigation for Region IV in Salt Lake City. Mr. Hunt started with the Bureau of Reclamation at Yuma in 1936, spent five years in the Army, and returned to the Bureau of Reclamation at Salt Lake City in 1946 and his most recent assignment at Carson City, Nev., in 1951.

Helmer A. Holmstrom, Colonel, Corps of Engineers, has recently been assigned as assistant chief of staff G4 for XVIII Airborne Corps and Ft. Bragg. Prior to this new assignment, Colonel Holmstrom was the Corps engineer, and from 1954 to 1957 he was commander of the 32nd Engineer Construction Group in Verdun, France, and the U. S. Army Engineer Depot command in Toul.

Walter H. Price, with the U. S. Bureau of Reclamation since 1930, was recently awarded the Department of the Interior's Distinguished Service Medal as a tribute to an eminent career in concrete technology. He is currently chief of the Division of Engineering Laboratories in the Denver office. Under his direction of the Concrete and Metals Laboratory, some of the greatest advances in concrete mix design and construction methods have been realized. In 1951 all laboratories—earth, hydraulic, chemical engineering, and concrete—came under his guidance.

BUTTERWORTHS SCIENTIFIC PUBLICATIONS

REGIME BEHAVIOUR of CANALS and RIVERS

By T. Blench, D.Sc., Professor of Civil Engineering, University of Alberta. $6.00

The aim of this book is to give the practising engineer the means to solve, with practical quantitative accuracy, problems that arise in dealing with canals and rivers that form their boundaries from sediment and so will not submit to arbitrary interference.

DESIGN of LAND DRAINAGE WORKS

By R. Berkeley Thorn, B.Sc., and Associates. $7.00

This book fulfils for all concerned with land drainage a long-felt need, and in particular a need for a handbook on detailed design for everyday use by both the experienced designer and the newly graduated engineer faced with his first design problems.

Descriptive leaflets are available on request from:

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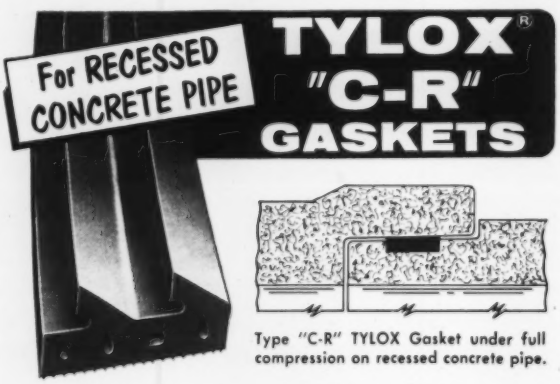
For RECESSED CONCRETE PIPE

TYLOX® "C-R" GASKETS



Type "C-R" TYLOX Gasket under full compression on recessed concrete pipe.

TYLOX "C-R" True-Compression Type Gaskets are designed for tongue and groove, or bell and spigot concrete pipe of all sizes having a recess on the pipe tongue, or spigot, for seating the joint. "C-R" Gaskets consist of heavy base bands having integrally formed, multiple sealing fins. These compress against pressure pockets in the base as pipe is coupled, to form a water-tight joint capable of withstanding head pressures up to 50-feet.

"C-R" Gaskets may be "snapped on" the pipe at the job site, or pre-assembled by the pipe manufacturer. Available in rubber or neoprene, and specially compounded to resist sewerage and industrial waste acids, they never deteriorate. Write for brochure.

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Milton S. Sachs, Bonneville Power Administration hydraulic engineer for the Department of the Interior, left November 27 on a six-week assignment in Ethiopia as a consultant to the United Nations Special Fund. Mr. Sachs will make a water resources survey of the Awash river valley in eastren Ethiopia to determine the potential of flood control, irrigation and other beneficial water uses. His headquarters will be Addis Ababa.

J. David Welch and **Martin Malinofsky** are partners in the new consulting engineering and geology firm of Welch and Malinofsky, at 382 Springfield Avenue in Summit, N. J. Both men have been associated with Howard, Needles, Tammen & Bergendoff of New York and Kansas City. Mr. Welch was chief soils engineer and in this capacity worked on the New Jersey Turnpike and the Delaware Memorial Bridge Projects, while Mr. Malinofsky was engineering geologist.

Clayton O. Dohrenwend, dean of the graduate school of Rensselaer Polytechnic Institute, has been named Provost. Succeeding Dr. Dohrenwend as dean is **Edwin B. Allen,** the present head of the department of mathematics. Dr. Allen will continue as head of the department.

L. H. Rosenthal, a thirty-five-year Portland (Ore.) city service employee, was recently appointed city engineer. Many years in the position of assistant city engineer plus earlier experience in the Army Corps of Engineers have prepared Mr. Rosenthal for his new post. While with the Corps of Engineers he assisted in the design of the locks at Bonneville Dam—at that time the highest single lift lock in the world and capable of handling sea-going ships.

Gordon T. Righter is the new assistant to the port director in the Department of Port Operations and Development in Miami, Fla. His last position with the Department was as port engineer.

Douglass Taber has been appointed manager of the Eastern Region of B-I-F Industries, Inc., of Providence, R. I. Mr. Taber, who was previously in charge of field sales and service and has been manager of one of the company's district offices, will make his headquarters in New York City.

Russell A. Stephenson on November 2 assumed the position of Region 8 bridge engineer with the Bureau of Public Roads, with headquarters in Portland, Ore. Mr. Stephenson has a background of thirty-six years of experience in the highway bridge design and construction field, including terms as bridge engineer on the Inter-American highway in Bolivia; designer in the Western Headquarters of the Bureau of Public Roads in San Francisco; and bridge engineer of the Montana Division.

Herman F. Bahmeier, regarded as "Dean" of the Bureau of Reclamation's construction engineers, recently received the Department of the Interior's highest honor, the Distinguished Service Award "In recognition of signal engineering achievements which are a credit to the Federal Government." Mr. Bahmeier retired last May as head of the Department's projects office at Grand Junction, Colo., after a long and distinguished career with the Bureau of Reclamation going back to 1930. Many of his projects involved unusual and difficult engineering and construction problems never before encountered.

Richard L. Sloane, soils consultant for the Pittsburgh Testing Laboratory in Salt Lake City, has accepted an assignment at the University of Arizona in Tucson to teach graduate studies in soils mechanics.

Clifton T. Kent, formerly senior staff engineer of the Pennsylvania Turnpike Commission, Harrisburg, Pa., has been appointed assistant executive secretary of the Pennsylvania Society of Professional Engineers in Harrisburg. With time out for service in World War II and the Korean conflict—he attained the rank of major, Mr. Kent has been on the Turnpike Commission staff since 1938.

Howard Jacoby has founded Jacoby & Associates, Inc., a firm offering engineering electronic computation and aerial photogrammetry services, with offices in Hicksville, N.Y. Mr. Jacoby was Senior Editor of Engineering News-Record, from 1955 to 1958, and since the latter year has been chief computer services engineer of Photronix, Inc., Columbus, Ohio.

James S. Sweet, staff hydrologist of the U. S. Weather Bureau, Washington, D.C., has returned from a trip to South America where he evaluated proposed hydrometeorological networks in Chile and Ecuador for the United Nations Special Fund.

Richard Sullivan recently resumed his employment with the City of Phoenix (Ariz.) as civil engineer II with the Public Works Department, after two years as public works director of Pacific Grove, Calif. Mr. Sullivan, who will act as administrative assistant to the Public Works director, previously served an internship with the city government.

Harry F. Blaney, irrigation engineer with the U. S. Department of Agriculture, Los Angeles, Calif., recently completed a five-month tour inspecting irrigated areas in Greece, Turkey, Israel, Pakistan, India, Thailand, Japan and Hawaii. Three months were spent in Israel evaluating irrigation research and water utilization for the U. S. International Cooperation Administration. Mr. Blaney is chairman

(*Continued on page 24*)

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News of Members

(*Continued from page 23*)

of the Water Conservation Committee of the Irrigation and Drainage Division of ASCE.

Mathew V. Pothier, Colonel, Corps of Engineers (retired), after a career of twenty years of military service and a more recent four-year assignment as associate professor of civil engineering at Ohio Northern University, has joined the staff of Finkbeiner, Pettis & Strout, Toledo, Ohio consulting engineers.

Edward Ottoman was honored recently at a testimonial dinner by the Chicago Technical College for fifty years of service. Dr. Ottóman, who is now training director of the extension division, joined the staff in 1909. Since then he has been teacher, counselor, technical writer, dean and secretary.

Wallace B. Short, Rear Admiral, Navy Civil Engineer Corps, retired recently from active duty. Admiral Short's last post was as director of the Pacific Division in the Bureau of Yards and Docks with headquarters at San Francisco.

Jerold B. Van Faasen has been transferred from the U. S. Army's Seattle office where he was resident engineer to the Glasgow Air Force Base in Montana, to take charge of a $30-million construction program there. For the past five years, Mr. Van Faasen has supervised construction at the twelve Nike missile batteries which ring the Seattle area, the Missile Master control installation nearing completion at Fort Lawton, the start of the BOMARC missile facility at Paine Air Force Base and radar sites and Army Reserve Training Centers in the area.

James B. Smith, an employee of the Raymond Concrete Pile Company since 1947, has been named Kansas City district manager by Raymond. In that time, Mr. Smith has served in a number of district offices as a superintendent and has also worked on the Spanish Air Bases Project.

Charles Haley, Phoenix (Ariz.) traffic engineer was elected vice president of the Western Section of the Institute of Traffic Engineers at the group's annual meeting held recently in Seattle. For the past two years, Mr. Haley has served as secretary-treasurer of the Western Section.

Louis G. Kisseleff has resigned as associate traffic engineer with the City and County of Denver to accept the post of traffic engineer with the Department of Legal Medicine at the Harvard University Medical School. Mr. Kisseleff is a member of a team engaged in a five-year research study of fatal traffic collisions under a grant from the U.S. Public Health Service.

William H. Claire has resigned as assistant executive director of the Los Angeles Community Redevelopment Agency to open a practice as urban renewal and planning consultant at 305 East California Boulevard, Pasadena, where he will also be the Western representative for Homer Hoyt Associates, of Washington, D.C. Mr. Claire, who joined the Agency staff in 1951 guided the first redevelopment project in California from its start in 1954 to near completion today. At the time of his resignation he was in professional charge of the current $65.5 million Bunker Hill project.

Joseph A. Leadabrand, formerly manager of the soil-cement bureau of the Portland Cement Association, is the new assistant to the vice president of the Association in Chicago. Since joining Portland Cement in 1936 as a soils engineer, he has served as supervisor of the soil and soil-cement testing programs and as manager of the soil-cement bureau for ten years. Succeeding Mr. Leadabrand as acting manager is **E. Guy Robbins.** Mr. Robbins joined the Association in 1937 as a soils testing engineer and has served as research engineer, soil-cement field engineer, and senior paving construction engineer.

Robert W. Shaffer, veteran civil and structural engineer associated with major public works projects throughout the West, has joined the Los Angeles office of Wilsey and Ham, Engineers and Planners. In the past sixteen years, Mr. Shaffer has carried out hydrographic studies on the Rio Grande and several dam investigations and design.

Edward Wenk, Jr., recently resigned as chairman of the Department of Engineering Mechanics at Southwest Research Institute, San Antonio, Tex., to accept an appointment in the newly created post of senior specialist in Science and Technology with the Legislative Reference Service at the Library of Congress. Dr. Wenk's appointment represents an extension of activities to deal with assignments on policy matters in the field of science and technology.

J. C. Womack has been promoted from assistant state highway planning engineer in the California Division of Highways to deputy state highway engineer with headquarters in Sacramento. Mr. Womack joined the California Division of Highways as location engineer for District III in 1929. He was promoted to planning engineer in 1948 and to assistant state highway engineer with supervision over six departments in 1955.

(*Continued on page 110*)

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plants serve more than 85 percent of the U.S., assuring you of quick technical help when needed and fast delivery of such precast concrete products as:

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1. LO-HED PIPE carries a greater flow than its round equivalent—in a shallower trench with adequate depth of cover.

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A-M's elliptical concrete pipe was chosen for this combination sewer project because of its increased self-cleansing velocities at periods of dry-weather flow—and used in three ways on this single job . . . as Lo-Hed, Hi-Hed and Inner Circles Pipe. The two mile line, engineered by Consoer Townsend & Associates, Chicago, runs from the Teletype Corporation in Niles, Illinois, to the north branch of the Chicago River.

American-Marietta's reinforced elliptical, as well as round, pipe is available in a full range of sizes with pretested strengths to meet various specifications—can be delivered in quantity when and where needed from any of A-M's many plants located from coast to coast.

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3. INNER CIRCLES PIPE allows passing of pipe through pipe underground without requiring excavations or disruption of surface traffic. Permits faster work at less cost in any weather.

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The new *360* gives you more big-production features than any other big scraper, too: high-torque engine characteristics and snappy acceleration . . . full 90° steering . . . 10-ft apron lift . . . torque-proportioned traction . . . *plus* the new standards of all-hydraulic performance spotlighted at the right.

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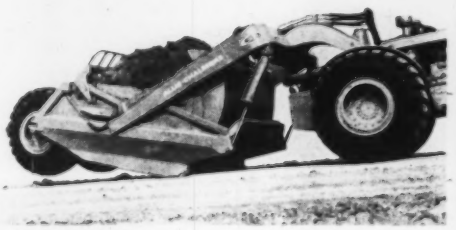
Everything you'd want in a big motor scraper if you were building it for your own jobs!



Double-acting bowl jacks put enough penetrating force on the cutting edge to pivot the *scraper and its load* clear of the ground.

KON-TORK is an Allis-Chalmers trademark.

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TS 360

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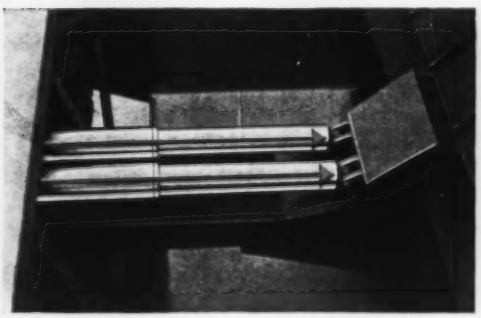

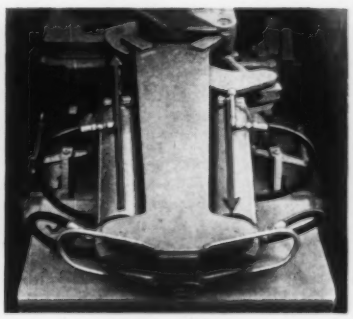

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. . . . . *Am-Soc Briefs*

▶ ▶ With the New Year the obvious time for beginnings, "Civil Engineering" is trying something new starting in this issue. In an effort to give members maximum news about their Society, items of ASCE news are interspersed with the articles, wherever they can be fitted in. In addition, of course, there is the usual solid block of news — under the new head of ASCE News and in a new location amid the articles.

▶ ▶ With New Year's also the time for making good resolutions, the thirty-odd thousand members who have not yet contributed to the United Engineering Center financing campaign cannot do better than resolve to make a pledge — however modest — and then see their resolution through. . . . Cause for optimism is the fact that Districts 1 and 9 have joined District 4 in topping their goals. Zone 1 leads the other Zones with 97 percent of its quota subscribed.

▶ ▶ Dedicated members. . . . Fewer than 2,000 of the 44,000 members of ASCE do the work of the Society by manning its committees, professional and technical. The recently appointed professional committee personnel for 1960 — the few to whom the rest of the membership owes so much — are listed in the ASCE News section.

▶ ▶ New Orleans is next. . . . Spring will be in full flower in New Orleans in early March, when the city is host to the Society's Spring Convention, set for March 7–11. Some of the attractions — of both city and program — are discussed in this issue (page 40). The complete program is scheduled for the February issue. . . . Another set of dates to be remembered is April 4–8, when the 1960 Nuclear Congress will take place in the New York Coliseum. ASCE portions of the comprehensive program, which is being readied by some thirty societies, are described in this issue (page 41).

▶ ▶ Though ASCE has always looked upon its younger members as the indisputable asset they are, time was when this valuable group was not assimilated in Society activities as it is today. A study of the changing and developing role of the younger member, as revealed in a study of thirty years of "Civil Engineering," is used this time as "The Younger Viewpoint."

▶ ▶ New ASCE award. . . . The Soil Mechanics and Foundations Division is sponsoring a move to honor Prof. Karl Terzaghi, Honorary Member of ASCE and internationally known expert in soil mechanics, by setting up a Society award in his name. Contributions toward the endowment are invited by the Terzaghi Award Committee (page 67).

#6

SPECIFY RODNEY HUNT
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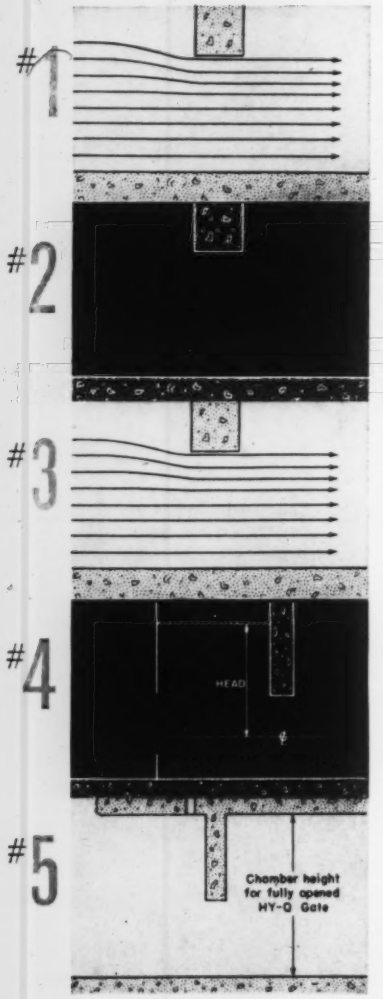
HY-Q® Sluice Gates Mean Construction Economies



Because of the improved flow characteristics of the Rodney Hunt HY-Q sluice gate, a given volume of flow can be handled with a smaller gate size, narrower channel and lower channel walls than are required for a conventional gate. Thus there are often substantial economies effected in concrete construction. This improved flow is the direct result of the 5 other design advantages of the Rodney Hunt HY-Q sluice gate:

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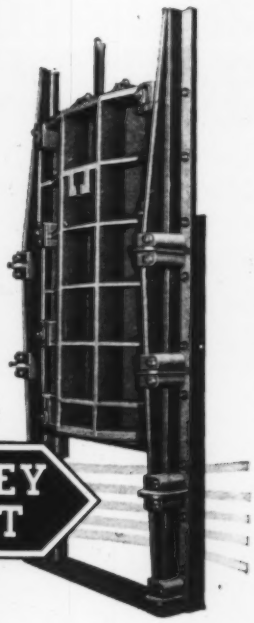
#3 HY-Q Sluice Gates Eliminate Interference with Flow

#4 HY-Q Sluice Gates Assure Maximum Hydraulic Gradient

#5 HY-Q Sluice Gates Permit Lowest Possible Invert

All these advantages derive from the design of the resilient seal fastened to the bottom of the disc. The seal extends the full width of the disc and provides a cushioned closing at the stop bar flush with the invert.

The HY-Q gate offers unmatched design flexibility and construction economy for water control projects . . . with hundreds of gate sizes available from 6" x 6" to 144" x 144" and larger to meet your specific design requirements.



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do you know that

The modern highway is the theme of this issue? With the world on the move as never before, new roads are planned or under construction from Rio de Janeiro to Tokyo and from Moscow to Cape Town. Though the U.S. increased its highway expenditures by 38 percent in the 1955-1958 period, the other free-world countries showed a 95 percent increase in their spending for new roads in the same period. The gospel of good roads has been spread by the technical exchange programs of such groups as the U. S. Bureau of Public Roads, the International Cooperation Administration, the International Road Federation, and U. S. colleges and universities.

■ ■ ■

In the U. S. toll roads are increasingly popular? In 1950 the United States had only 424 miles of toll roads in use, while in 1959 toll road mileage had increased to 3,103 miles, representing an investment of over $5 billion. Better times have made the toll roads more prosperous, too. Typical is the Kansas Turnpike, which reports that tolls for the first ten months of 1959 were 14.4 percent above those for the comparable year-ago period.

■ ■ ■

The states will receive $2,725,000,000 in federal aid in 1961? These funds, which continue the expanded national highway program launched in 1956, comprise $1,800,000,000 for the National System of Interstate and Defense Highways and $925,000,000 for the so-called ABC program (primary and secondary systems and their urban extensions).

■ ■ ■

Highway construction costs rose slightly in the third quarter of 1959? The rise of 0.2 percent follows a decrease of 2.7 percent in the preceding quarter and of 0.6 percent in the first quarter of the year. Despite the currently reported rise in costs, the index is 1.4 percent below the level of a year ago. What's more, it actually costs less to build a typical mile of federal-aid highway than it did during the first three months that the 1956 Highway Act was in effect.

■ ■ ■

Motor vehicle registrations will top 70 million in 1959? When 1959 registrations are counted, they are expected to reach 70,416,000, or 3.1 percent more than 1958 registrations, according to Federal Highway Administrator Tallamy. The rate of increase reverses declining trends of the past few years. California leads the states with 7.3 million registrations, followed by New York with 4.9 million. Texas and Pennsylvania will each have slightly more than 4 million; Ohio, Illinois, and Michigan, over 3 million; and New Jersey and Florida, over 2 million. These nine populous states account for 51 percent of the total registrations.

■ ■ ■

The dark side of the highway picture of course is the accident toll? Some 1.33 million persons have lost their lives in highway accidents in the U.S., and an estimated 4,000,000 have suffered permanent injuries. Property damage is in excess of $90 billion. The toll for 1958 was 36,700 killed and 2,825,000 injured. Excessive speed was blamed for more than 40 percent of the 1958 traffic deaths and injuries. The statistics are those of the Highway Safety Study of the Bureau of Public Roads and the Travelers Insurance Companies.

■ ■ ■

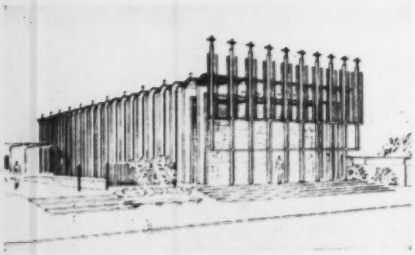
The cost of keeping our roads clear of snow is enormous? The annual cost of removing snow from the highways in the northeastern United States alone is put at $45,000,000 by "The New York Times." The New York Thruway figures it averages $2,700 a mile on winter maintenance.

■ ■ ■

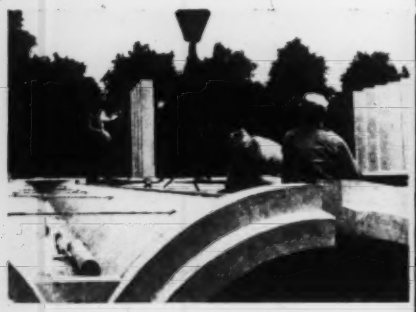
Use of waste chemicals to reduce paving costs is a possibility for the future? Tomorrow's highways may be laid by a machine that, in one operation, digs up the ground and leaves a roadway as hard as concrete in its wake at a fraction of the cost of today's highways. In a recent TV school program Dr. Ronald Scott, of the California Institute of Technology staff, said that the versatile machine would mix raw earth with waste chemicals that bind the soil. When the resultant mixture dries, it is hard enough for highways, air strips, and dams. Many chemicals, including salt and lime, are suitable for binders.

■ ■ ■

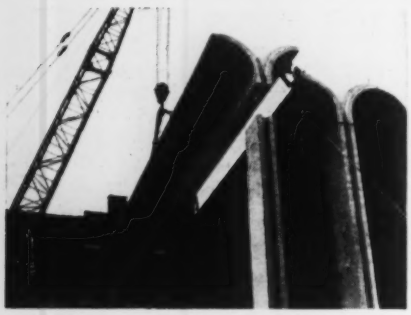
Civil engineers have a greater part in the missile program than is generally realized? They have been successful in building structures to withstand 360,000 lb of take-off thrust and heat from the missiles. Who is building the big Vandenberg Air Force Base, and how, is told by Capt. N. N. Stout, of the Ballistic Division of the Air Force, in an article in the February issue. Engineers will be interested in the new field, where even greater challenges for launching space rockets are expected soon.



PITTSBURGH CHURCH OF Precast Concrete



The 20 Y-units are 53' long, have 3" shells. Vaults have a 27½" radius and rise to 24' above floor level, supported on precast columns spaced 5' 5" on centers.



HOLY TRINITY GREEK ORTHODOX CHURCH
Pittsburgh, Pa.

Architect: **JAMES A. MITCHELL,** Pittsburgh, Pa.

Consulting Engineer (Structure):
NORMAN K. LONG, Pittsburgh, Pa.

Consulting Engineer (Precast Sections):
CHARLES H. WOLF, Philadelphia, Pa.

General Contractor:
SAMUEL N. ZARPAS, INC., Pittsburgh, Pa.

Precast Columns and Roof Members fabricated by:
FORMIGLI CORPORATION, Berlin, N. J.

● Byzantine architecture has been given an impressive new treatment in Pittsburgh's Holy Trinity Greek Orthodox Church, constructed of precast concrete units.

Although the original design called for monolithic reinforced concrete, the architect and contractor decided to save time with precast units which could be stockpiled during the Winter for rapid erection in warm weather. Precast concrete would provide all the inherent values of reinforced concrete—fire-safety, corrosion-resistance, rot-resistance low initial cost and maintenance-free service—and in addition, the architect felt, it would also increase the aesthetic acceptability of the structure.

Barrel arches for the nave are comprised of Y-shaped precast units placed alongside each other and supported by precast columns. Lightweight concrete fills the rooftop valleys.

Fabricated nearly 300 miles from Pittsburgh, the units were hauled over the mountains by truck on a tight delivery schedule closely coordinated with construction progress. 'Incor'®—America's *first* high-early strength cement—was used by the precast producer to assure maximum quality in each unit, as well as maximum precasting economy.

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Planning, construction, and maintenance of the U.S. network of highways requires the services of perhaps more civil engineers than any other activity. In the following pages, engineers concerned with the many facets of adequate highways discuss what is being done in the highway field, what is new, and what is coming.

CIVIL ENGINEERING

charting the highway program through 1960

B. D. Tallamy, F. ASCE

Federal Highway Administrator

Bureau of Public Roads

U. S. Department of Commerce

Washington, D. C.

■ I HAVE EVERY confidence that highway officials will have continued success in charting the highway program through 1960. This confidence is based on the record of solid achievement by these dedicated public servants since the greatly expanded highway program was made possible by the Federal-Aid Highway Act of 1956. Their accomplishments in the past few years will make some very bright pages in the history of civil engineering.

When data on progress have been compiled, they will show that Federal-aid highway construction projects valued close to $7.5 billion have been completed in the three and a half years from July 1, 1956, to December 31, 1959. These contracts resulted in improvements on about 100,000 miles of the Federal-aid highway systems. Dollar-wise, they constitute more Federal-aid highway improvement projects on these systems than were completed during the first thirty years of the Federal-aid highway program altogether! In addition to these achievements on the Federal-aid systems, capital expenditures for road improvements other than on the Federal-aid systems rose from $1.3 billion in 1956 to an estimated $1.6 billion in 1959.

Charting and navigating the course of the highway program through the past three and one-half years was far from a simple, routine task. Prior to passage of the 1956 Act, the very size of the program that was being considered raised questions as to the ability and readiness of each segment of the highway industry to complete the work efficiently, economically, and in a reasonable time. All segments of the highway industry joined together in a fact-finding self-appraisal of their respective capacities to undertake the successful completion of the proposed program.

Serious problems were found through this appraisal but they could be solved with an all-out effort and mutual cooperation of all in the highway industry. And solutions were found to many of these most pressing problems so that the highway program has gone forward on its charted course and on schedule.

One problem that required solution before we could even start was to win and hold public support for an expanded and sustained program of highway improvements. The facts as to the social and economic benefits that would accrue from these needed highway improvements were laid before the people all across the Nation. That their decision was affirmative and their support was forthcoming is evidenced by the progress made in the past three and one-half years.

How the shortage of engineers was overcome is now a familiar story. The electronic computer, new developments in photogrammetry, radio for communication and for other newer applications—all these and others too, have produced a renaissance in highway engineering. These modern engineering techniques have enabled highway officials to bring highway improvement projects to the construction stage at a greatly accelerated rate.

In accelerating engineering productivity, however, highway officials did not

overlook the fact that there must be no sacrifice in the quality, safety and service built into highway improvement projects. On the contrary, specifications were reviewed and in many instances revised to incorporate the latest findings of research and proven new developments. Minimum design standards were developed cooperatively by the state highway departments and the Bureau of Public Roads. These standards insured that the benefits of forty years of highway engineering experience in this country would be integrated into the highway program.

Much additional spadework has been done in preparation for this tremendous program. And the effort to find further improvements is continuing. Research programs have been expanded and intensified. New developments in materials, equipment and procedures are under study all over the country. I have seen no lessening in the determination of either state or federal highway engineers to carry out this program with maximum economy and efficiency.

Solid achievement

As this new year begins, there is no doubt in my mind that the highway industry has geared itself well to continue the record of solid achievement in the highway program. In charting the course of the highway program for 1960, however, new factors and trends must be considered.

During this year, the Federal-aid program will go forward under a system that requires scheduling of Federal fund obligations in advance in order to insure prompt payment to the states for expenditures incurred. This is a new requirement, having been put into effect only last October. It is necessary because of the pay-as-you-go provision of Section 209(g) in the Federal-Aid Act of 1956, which requires that in any fiscal year expenditures of Federal funds shall not exceed the estimated Highway Trust Fund revenues available.

By developing and adhering to a schedule for obligating Federal funds, prompt reimbursements to the states can be made as vouchers come due. The revenues accruing to the Highway Trust Fund under the provisions of the 1959 legislation will be adequate to provide for prompt reimbursement to the states for all contractual obligations incurred prior to July 1, 1959, plus $2.725 billion of new or additional obligations during the fiscal year ending June 30, 1960. Each state has been advised of its proportionate share of this amount of new obligations for which prompt reimbursement can be made.

On October 8, 1959, the Secretary of Commerce apportioned to the states $2,725,000,000 in Federal funds for the fiscal year 1961. They are available for obligation in accordance with reimbursement planning procedures which will insure prompt payment of vouchers when due.

Therefore, in 1960 Federal-aid funds will be obligated in accordance with a schedule developed on a quarterly basis, which will be geared to estimated revenues in the Highway Trust Fund. It will be necessary to include obligations for preliminary engineering and right of way as well as contract awards in these schedules.

The Federal-Aid Highway Act of 1959 will permit the highway program to go forward but at a somewhat reduced rate. We expect that capital expenditures for highway improvements during the calendar year 1960 on all roads both on and off the Federal-aid systems will approach the $7.0 billion mark. The level of capital expenditures for highway improvements off the Federal-aid systems is expected to continue its upward trend. In addition, any state may proceed with improvements to the Federal-aid highway system at a faster rate than can be supported by the Highway Trust Fund without delay in reimbursement. However, the federal share in the cost of such improvements could be paid later when the revenues in the Fund permitted.

We have seen that the various segments of the highway industry have prepared themselves to keep the expanded highway program on schedule. Funds are available to sustain a continuing program through 1960. But in charting the highway program through 1960, we must not presume that all will be clear sailing. For example, we may be questioned again about the need for a program of this size. But from our studies and research, we know the need is there. This year it is estimated that motor vehicles will travel about 725 billion miles over our roads and streets. By 1971, the annual motor vehicular travel will be over one trillion miles, more than 40 percent of which will be on roads and streets in urban areas. If we are to provide for the safe and efficient movement of this traffic and if we are to enjoy the economic growth dependent upon these highways, they must be developed. We must constantly keep our citizens informed of the facts underlying this need if public support is to be sustained.

The necessity for access control may again be debated. Down through the years of our engineering experience we have studied the accident records on roads of all types. On those carrying large volumes of high-speed traffic, the accident records have shown clearly that the highways with access control are many times safer than those where random entrance and exit of vehicles is permitted. It is estimated that access control on the Interstate System will save at least 4,000 lives annually when completed. In addition, it will protect the investment in these roads from accelerated obsolescence.

During 1960, the highway program and our activities will be subject to close scrutiny. Underlying concepts and legislative intent will be the basis for appraising the conduct of the program. We should have no objection to such an appraisal. We will welcome constructive suggestions which will help us integrate further improvements into the highway program. At the same time, such an appraisal will be beneficial in the development of a better understanding of our problems. These studies should reveal more widely how the cost of engineering the program has been greatly reduced through the widespread adoption of streamlined methods and procedures; also the new developments in construction equipment and methods that have meant such substantial economies in building these roads for tomorrow, and the extent to which the cost of our highway structures is being held down because highway engineers have introduced new materials, new methods and other improvements.

Long-range benefits

Substantial as these economies are, they are minor compared to the long-range benefits from the improvements that have been introduced into the highway program through the joint cooperative efforts of the Bureau of Public Roads, the state highway departments, contractors and all other segments of the highway industry. With the new engineering tools, the highway designer can readily explore more alternate locations, alignments and grades. The bridge design engineer also can be far more precise and, therefore, more economical. With the tools we now have, traffic analyses and forecasts can easily be made with a thoroughness that a few years ago would not have been attempted because of the time involved.

These improvements will mean savings in construction costs, savings to highway users of the future in operating and accident costs, and savings to all of us because, through modern engineering, these roads for the future will have a long life of adequate service.

In charting the course of the highway program through 1960, I see no insurmountable obstacle. I see no problem that cannot be solved through the mutual cooperation, understanding and good will of all concerned. The year 1960 should be another year of solid achievement.

THE AASHO ROAD TEST

FRED BURGGRAF, F. ASCE, Director, Highway Research Board, Washington, D. C.

W. B. McKENDRICK, JR., F. ASCE, AASHO Road Test, Project Director, Highway Research Board, Ottawa, Ill.

The AASHO Road Test is primarily a study of the performance of highway pavements and short-span bridges of certain structural designs when subjected to controlled traffic with certain specific loadings. It is the largest such project ever undertaken, and the first to use the techniques of statistical experiment design. The research phase of the project began in the fall of 1958 and has been under way for about 15 months. Thousands of instruments of an electrical or electronic nature have assisted the research staff in accumulating a large mass of data, which is in the process of analysis.

The orderly progress of the experiments, the functioning of complex instrument systems, and the increasing efficiency of test operations, are convincing evidence that the project contains sound and well-designed experiments that will produce much valuable engineering information. Thus, the test will play an important role in the total engineering and economic process of providing highways for the nation.

Previous articles have described the background and concepts of the project (CIVIL ENGINEERING, Dec. 1956 and July 1957). A brief review is included here.

The project is sponsored by the American Association of State Highway Officials, and is administered and directed by the Highway Research Board of the National Academy of Sciences—National Research Council. The Highway Research Board is conducting the test through a National Advisory Committee and ten special panels, all of which are composed of individuals of recognized competence in highway research and development.

The project is cooperatively financed by the 48 continental states, the District of Columbia, Hawaii, Puerto Rico, the Bureau of Public Roads, the Automobile Manufacturers Association, the American Petroleum Institute, and the American Institute of Steel Construction. The Department of Defense is cooperating and assisting.

Construction of the test facilities, which required a two-year period, was carried out under rigid controls aimed at securing uniform quality. The data have shown that the desired uniformity was attained.

The test facilities consist of six independent loops of highway pavement. Four loops, each 3.1 miles around, were built end to end along an eight-mile right of way. Two smaller loops were built adjacent to one of the larger loops. Sixteen bridge spans, one lane wide and 50 ft long, were built at four locations in two of the large loops.

Each loop was built as a straight section of four-lane, divided highway with superelevated turnarounds connecting the lanes at each end. The pavement on one side of the median strip is portland cement concrete; that on the other side, asphaltic concrete. Both types of pavement were constructed in short sections of varying structural design.

Rigid pavement slabs range from 2½ to 12½ in. thick with a sand-gravel subbase of zero, 3, 6, or 9 in. Each design occurs in both plain and reinforced slabs.

Flexible pavement surfacing ranges from surface treatment to a thickness of 6 in., with a crushed limestone base of zero, 3, 6 or 9 in., and a sand-gravel subbase of zero, 4, 8, 12 or 16 in.

All pavements are placed on at least 3 ft of uniformly constructed embankment. The embankment soil can be described as a yellow-brown, A-6 soil (AASHO classification) having a group index of about 9 to 10. The standard AASHO maximum density is 116 lb per cu ft (pcf); optimum moisture is 15 percent; liquid limit is 29.5; and plasticity index is 13. Approximately 80 percent passes the No. 200 sieve and 63 percent is finer than 0.02 mm.

The subbase material is a natural uncrushed glacial outwash sand-gravel mixture. This material was washed and blended with approximately 20 percent white silica sand and about 2 to 3 percent of silty soil, all obtained from the same source. Maximum density is about 137 pcf. The material passing the No. 40 sieve is non-plastic.

The base material is a crushed dolomitic limestone. Maximum density is

Road test facility stretches eight miles across flat Illinois farm land. Test loop in foreground carries vehicles with 18,000-lb single and 32,000-lb tandem axle loads.

TABLE I. Typical gradations of subbase and base materials

Sieve Size	Percentage Passing In Subbase	In Base
1½ in.	100	100
1 in.	100	90
¾ in.	97	80
½ in.	90	68
No. 4	71	50
No. 10	52	36
No. 40	27	21
No. 100	..	14.5
No. 200	7.5	11.5

about 139 pcf. The material passing the No. 40 sieve is non-plastic. Typical gradations of the subbase and base material are shown in Table I.

In both rigid and flexible pavements the design factor levels selected for each test loop occur in all possible combinations. Within each loop tangent there is, therefore, a complete factorial experiment.

The test traffic is operated in ten lanes on five loops. All vehicles in any one lane have identical axle loads and configurations. Loads are 2,000, 6,000, 12,000, 18,000, 22,400 and 30,000 lb on single axles, and 24,000, 32,000, 40,000 and 48,000 lb on tandem axles.

The sixth test loop is used for special tests under static or vibrating loads, subsurface materials studies, environmental studies, and to determine the effect of weather on pavements not subjected to loading.

Vehicles are operated by men from the U.S. Army Transportation Corps Road Test Support Activity, a special military unit stationed at the project. Operations cover about 18½ hours a day in two shifts.

Full-scale test traffic began on November 5, 1958. During the first 12 months the vehicles amassed a total of five million miles, and each pavement section remaining in the test received about 325,000 applications of load.

Shortly after the test traffic started, damage began to be evident in some of the extremely thin pavement sections and in the very highly stressed bridge spans. However, the advent of cold weather and freezing of the ground halted pavement damage for all practical purposes until the early spring of 1959.

During the winter of 1958-1959 the average depth of frost at the project site was 36 in., with some maximum readings above 42 in. Normal frost depth in the area of the project is about 28 in. When frost began to leave the ground in late February and early March, there was, as expected, a sharp rise in the rate of pavement damage.

An extensive program of pavement maintenance was required during the next three months in order to keep traffic moving as much as possible during this critical period. Considerable use was made of pierced-plank steel landing mats, furnished through the cooperation of the Army, as temporary riding surfaces over damaged sections.

Permanent repairs on both rigid and flexible pavements are made with bituminous material. Badly damaged sections are completely removed, and the underlying material dug out to a depth of 15 to 21 in. A crushed-stone backfill is compacted and covered with an asphaltic concrete surface 3 to 4½ in. thick. These rebuilt sections are no longer studied. However, in certain cases, it was deemed feasible to overlay damaged sections, and the behavior of these sections continues to be observed.

Certain bridge spans have also been declared out of test after developing permanent deformations of about 4 in. in the beams. All these spans were designed at stress levels far in excess of those used in current practice. Two spans, which showed damage early in the test, were replaced with spans of different design in order to take full advantage of the remaining months of controlled test traffic. The new spans were constructed adjacent to one of the test bridge sites, and moved into place with a minimum of interruption to traffic. They have been under test since June 1959.

All the various test bridge spans—steel, reinforced concrete, and prestressed concrete—were designed under different criteria. They are essentially 18 separate case studies, and are in no way comparable.

Measurements being made on the test pavements fall into two categories. Permanent deformations of the surface are measured in order to determine the performance of the various structural designs under known loading. Transient effects of traffic, such as strains, deflections, curvatures, and pressures, are measured with the aim of determining the capability of various pavements to carry a certain volume of traffic, applying known loads.

Many of the instruments being used were developed specifically for the project, and in themselves represent a step forward in highway research. Recording equipment is designed to determine the maximum output of the transducer, to digitize the output, and to punch the resulting number into paper tape. Wherever possible, the research engineers have used digital rather than analog methods of recording data. Such systems allow the collection of great quantities of data. Summarizing and analyzing this continous flow of information would be impossible without automatic data-handling equipment and high-speed computers.

Much valuable information has already been obtained and analyzed at the AASHO Road Test. However, the Highway Research Board is convinced that interim reports on the research would be premature, and that conclusions based on partial data might well be misleading. Therefore, reports on the research findings will not be published until the completion of the project. Two preliminary reports are being prepared and should be published in 1960. The first will cover the background and concepts of the project; the second will describe in detail the construction of the test facilities. Both reports will form a basis for complete understanding of the final reports.

One concept developed at the project is also basic to an understanding of the results of the pavement experiments. This concept involves the word "performance," which appears in the first objective of the Road Test. This objective, simply stated, asks the Highway Research Board staff to determine significant relationships between the performance of pavements of various structural designs and the loading applied to them.

Performance, of course, is a relative concept, normally described by some adjective term such as poor, fair, good or excellent. The performance of any product, whether it be a highway or a mousetrap, can never be anything except a matter of human judgment.

This being the case, it was necessary for the Road Test staff to develop some method whereby measurements made with instruments could be, in effect, substituted for human judgment. This has been accomplished by using a Pavement Rating Panel, representative of all highway users, to validate indices derived from objective measurements on highway pavements.

The 12 members of this panel made individual subjective ratings of 100 sections of in-service pavement in three Midwestern states. These ratings were made on the basis of "present serviceability," or the degree of readiness of the pavement to serve high-speed, high-volume, mixed traffic. The ratings were made on an adjective-labeled scale ranging from very poor to good, with numerical ratings from zero to five. The mean numerical rating of the 12-man panel is termed the "present serviceability rating."

Immediately following rating by the panel, various instruments used at the project were employed to make measurements on the in-service pavement sections. These measurements involve surface deformations—roughness, cracking, patching, etc. The various measurements are combined in an equation so that they result in a num-

ber which is approximately the same as the present serviceability rating made by the panel.

Ratings on 100 sections of pavement enabled the project's Data Analysis Branch to develop and refine this equation until it can reproduce the panel's rating of any section of pavement, at least within the range of error made by the panel on repeated ratings.

With this technique it becomes possible to use objective measurements made on the Road Test pavement sections to produce periodic index numbers. These indices are, within the permissible range of error, the same as present serviceability ratings which the panel would make if it were possible for it to rate each test section.

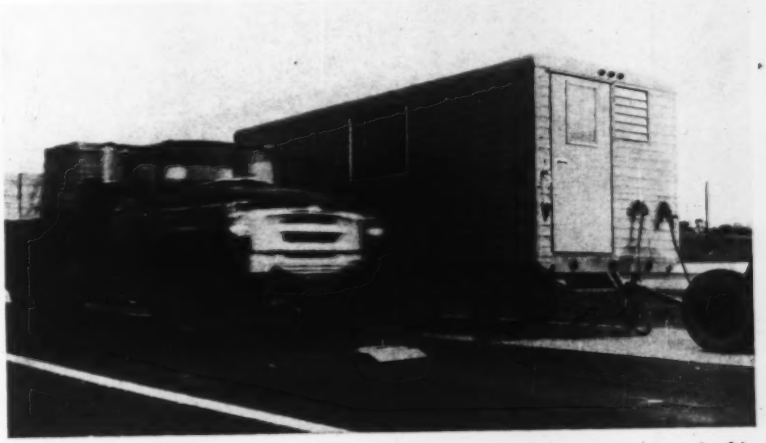
The present serviceability indices, produced every two weeks, are plotted against the number of load applications over a period of time to allow an assessment of the "performance" of each test section. The index of performance is the main dependent variable in the experiments, and will be plotted against independent variables—such as load, design and applications—in studies of the significant relationships called for in the first objective.

Briefly, this is the picture of progress being made at the AASHO Road Test, which is the largest and most comprehensive highway research project ever carried out. Basically, however, the test consists of three separate and distinct experiments, one relating to flexible pavements, one to rigid pavements, and one to short-span bridges.

The flexible and rigid pavement experiments are completely independent of each other and will require separate analysis. Any comparisons made between the respective results will require the introduction of engineering and economic data from other sources. Such comparisons should, therefore, be made by persons other than the Highway Research Board staff for the project.

The Highway Research Board has the responsibility of administering the project for the sponsor, the American Association of State Highway Officials, within the bounds of the objectives of the test. The Board is responsible for collecting the data, developing methods of analysis and presentation, as well as drawing valid and meaningful conclusions. The Board's role will end at that point. It will be up to the sponsor and its member departments to utilize the findings, as well as engineering and economic data from many other sources, to draw conclusions and prepare reports useful to the executive and legislative branches of all levels of government, and to highway administrators and engineers.

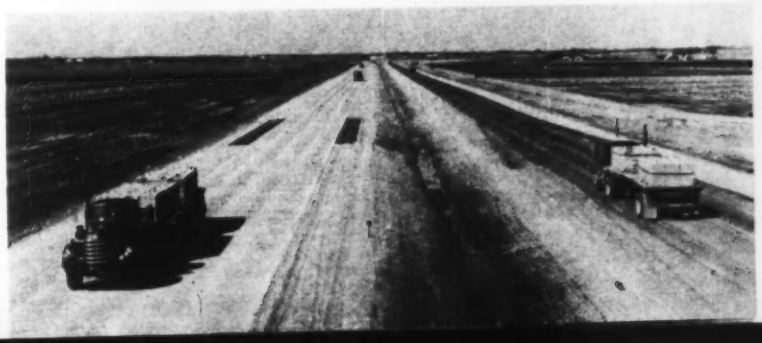
Short-span bridges are subjected to overstress at each passage of test vehicle. Cribbing under the spans is a safety measure.



Transient deflections under full-speed test traffic are recorded on instruments in this van. Device on the pavement records the transverse position of the vehicle.

Specially developed longitudinal profilometer measures the slope of the test pavements in each wheel path. Analog record is produced by instruments in touring van.

Test traffic operates at 35 mph along loop tangents. On the four main loops, single-axle vehicles run in the inner lane, tandems in the outer lane.



ROAD TO THE WINTER OLYMPICS

Looking south toward Squaw Valley from Route 40.

California has spent $58 million, has $10 million under contract, and expects to put $36 million more into reconstructing U.S. Route 40, now Interstate 80, from Sacramento across the Sierra Nevada to the Nevada line. See Fig. 1. Some 78 miles of the 114-mile stretch is now a full freeway with only 36 miles of conventional two-lane road remaining. An additional 7.7 miles of road, reconstructed to a width of 44 ft, connects this route with the site of the Winter Olympic Games at Squaw Valley, near Lake Tahoe. (See article on the ice arena, CIVIL ENGINEERING, September 1959, p. 46.)

Snow can be a serious problem in the Sierra Nevada where routes were earlier known as the Emigrant Trail, the Fremont Trail and the Donner Trail.

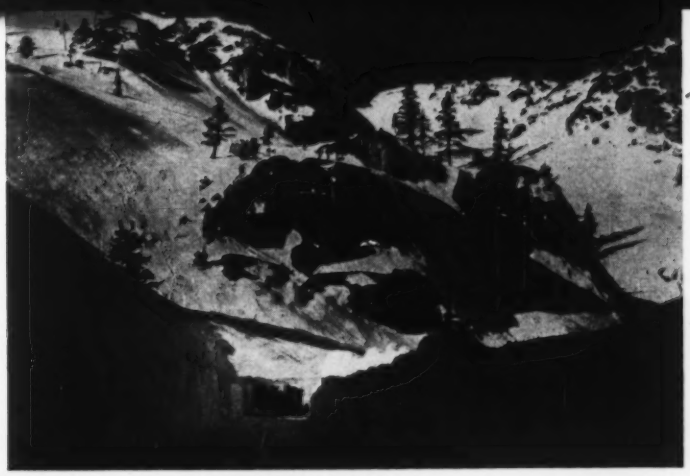
In past years, especially 1952, blizzards and avalanches caused the old road to be closed many times. The new road will have greatly reduced grades and more favorable snow conditions. Sixteen giant rotary plows, 76 conventional plows, auxiliary equipment for sanding and the like, and 150 California Highway Patrol officers will be available to keep the Road to the Olympics open and safe.

The "Hump" is one of the most heavily traveled highways at that elevation in the country, and one of the snowiest. Equipment for snow removal on the divided four-lane highway is designed for snowfalls of 12 in. per hour, 96 in. per day, 240 in. per week, and 480 in. per month. Such snows have been recorded in the past decade. In some cases the design has foreseen the need for storage sites for snow disposal.

Quantities on projects completed on Route 40 between Sacramento and the Nevada state line, in 1958 and 1959 only, are:

Roadway excavation	15,010,000 cu yd
Imported subbase material	1,413,400 tons
Untreated base	1,142,000 tons
Plant-mixed surfacing	338,189 tons
Concrete paving	284,230 cu yd
Concrete structures	55,060 cu yd

CIVIL ENGINEERING is indebted to Charles W. Schemel, assistant state construction engineer, California Division of Highways, for the information and pictures used here.



Snow removal at Donner Pass.

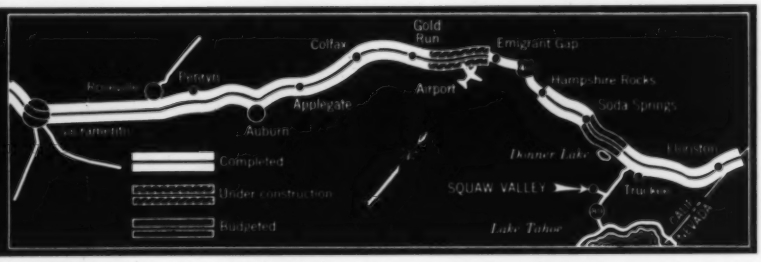
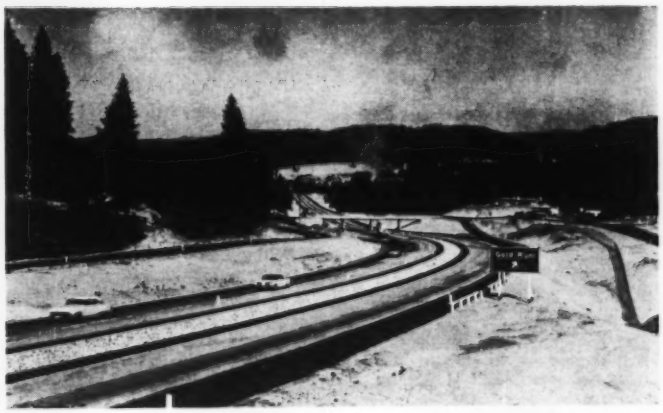


FIG. 1.
The Road
to the Winter
Olympics.



Route 40 in former hydraulic gold mining area.

Divided roadway near Soda Springs, opened to traffic in November 1959.

Truckee River Canyon between Boca and Floriston.

Keeping the road open with men and machines.

ASCE NEWS

New Orleans Will Be Host to ASCE Spring Convention

New Orleans is commonly called one of the three "most colorful and distinctive cities in the United States." The identity of the other two cities differs slightly, depending on who is talking, but New Orleans seems to remain a constant factor on all lists. The famous Southern city, which offers an unusual combination of Old World charm and up-to-the-minute engineering developments, will be host to the Society's Spring Convention. Headquarters for the Convention will be the Jung Hotel, and the dates are March 7-11.

Members who remember the Society's last New Orleans Convention in March 1952 will not need a second invitation to return to the scene of so much that is pleasurable. Others will be able to enjoy a New Orleans spring for the first time. The very fact that ASCE is returning so relatively soon to New Orleans gives an idea of its drawing power as a Convention city.

Research Activities Featured

With today's watchword the need for more engineering and scientific research, the research activities of ASCE will be featured on this year's New Orleans Convention program. In addition to emphasis on research in the various Division programs, the Society's Research Committee will sponsor a luncheon on Wednesday, March 9. The Society's five 1959 Research Prizes will be presented at this event, and Dean Morrough P. O'Brien, of the University of California Engineering College, will be featured speaker.

The Technical Program Committee, under the chairmanship of Prof. Walter E. Blessey, has arranged for sessions of eleven of the Society's fourteen Technical Divisions, plus a number of cooperative sessions involving several Divisions and presenting subject matter of broad professional interest. For instance, the Construction Division programs will feature descriptions of procedures of particular interest to structural engineers in some sessions, while other sessions will be of particular concern to the Waterways and Harbors Division. One whole session will be devoted to the use of admixtures in concrete; another to the construction of bridges; still another to the experience of contractors in constructing river locks.

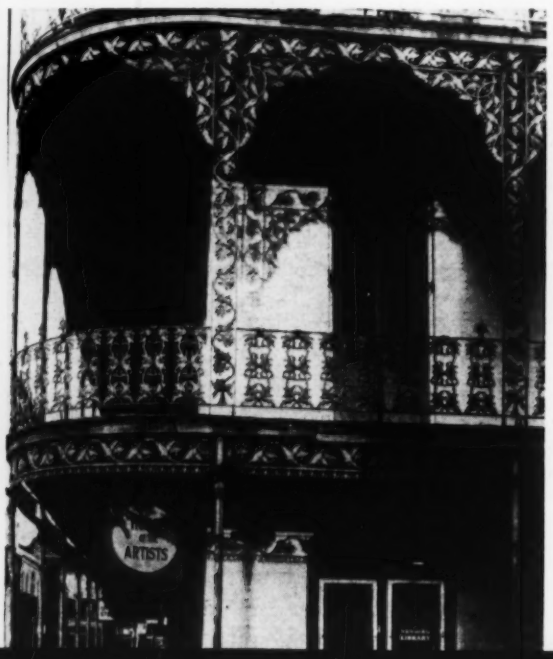
Similarly, the Structural Division and the Power Division are holding joint sessions featuring papers on design erection of transmission towers, massed and transmission lines. The Structural Division has a hand in five sessions with appeal to a wide range of interests. Much attention is also being given to water resources, with several Divisions presenting sessions in this area.

Program in the February Issue

Full details of the extensive program will be printed in the February issue.

In the meantime, it can be announced that several high-power luncheon meeting speakers have been lined up. These include Mayor de Lesseps Morrison, who in his long tenure in office has been instrumental in pushing the city's extensive improvement program. Of much interest also will be a talk by Maj. Gen. W. A. Carter, president of the Mississippi River Commission. One of the highlights of the ambitious social program will be the dinner dance on Wednesday evening.

Scene in the French Quarter (left) shows the lacework and the style of architecture typical of the Quarter. Most of the houses are constructed by a method called in New Orleans "briquete-entre-porteau," a system of using posts or beams on the diagonal and upright, and then piling the bricks in between. All this is then covered with plaster as shown here in the small bungalow in the foreground. Photo at right shows the famous New Orleans iron railings.



Much to See and Do

Engineers will find New Orleans second to none in projects of very special interest to the profession. Several inspection trips are being scheduled. In addition, engineers will want to drive or walk around and see for themselves what is going on. They will be able to see the recently completed Lake Pontchartrain Causeway, a concrete structure built in record time with the aid of new construction techniques; the new Mississippi River Bridge, the longest cantilever in the United States and third longest in the world; the union terminal and grade elimination project; and the special pumping plants (one of them the largest in the world) necessitated by the city's location below water level. The nation's second largest port, New Orleans is in the throes of a long-range, multi-million-dollar civic improvement program. The present International Trade Mart, which assembles exhibits of exotic products from all over the world, will soon be replaced by a new mart to be designed by the world-famous architect Edward Stone.

The ladies, in the meantime, will want to stroll in the French Quarter, the outstanding New Orleans attraction from the visitor's point of view. This famous section of the city remains much as it was towards the close of French and Spanish domination in the late eighteenth century. The narrow streets, the exquisite iron railings, the graceful fan windows, and the colorful courtyards seem a far call from the modern city. At every hand there is something to buy. In the Vieux Carré, too, are some of the world's best known restaurants, specializing in Creole cookery.

Program Announced for 1960 Nuclear Congress

A partial program of sessions planned for the 1960 Nuclear Congress, to be held in the New York Coliseum, April 4-7, has been announced by Dr. Clarke Williams, chairman of the Nuclear Engineering Department of the Brookhaven National Laboratory, Upton, N. Y., and chairman of the Nuclear Congress.

The Congress, a gathering of representatives from all areas of the nuclear field, is sponsored by 28 leading engineering, scientific, management, and technical organizations. Engineers Joint Council will coordinate the programs of the participating societies. ASCE has Congress management responsibility this year.

The Congress consists of the Sixth Nuclear Engineering and Science Conference, the Eighth NICB Atomic Energy in Industry Conference, and the Sixth International Atomic Exposition. The Exposition, which was established in 1954, will include at least 130 exhibits of the manifold products and services available for the peaceful use of atomic energy. More than 1,000 requests for information regarding participation in the exhibit have been received from firms all over the world, indicating the exceptional interest. The Congress sessions are expected to draw the largest audience of engineers and related specialists—as well as the largest representation of industrial and scientific exhibitors—ever to attend an event of this kind.

The theme of the meeting, according to E. B. Gunyou, program committee chairman of the Nuclear Congress, will be—"What Will the Future Development of Nuclear Energy Demand from Engineers?" This question will be approached through a series of reports, papers, and discussion on a wide variety of subjects related to the peaceful use of atomic energy.

Three Environment Sessions

Of special interest to civil engineers will be three sessions that will explore the environment problem of atomic energy. On plant construction and site location, for instance, four papers have been scheduled, with J. Cal Callahan, F. ASCE, of Morris Knowles, Inc., serving as chairman.

1. Current Cost and Construction Experience at Yankee Reactor Site, by C. T. Chave, Stone & Webster, Boston, Mass.
2. New Concepts in Containment Design will be covered in two papers: Pressure Suppression, by F. F. Mautz, Pacific Gas & Electric Co., San Francisco, Calif., and Pressure Liquidation, by A. F. Kolflat, Sargent & Lundy, Chicago, Ill.
3. Review of Shippingport Operations-Site Factors, by John E. Gray, coordinator of atomic power, Duquesne Light Co., Pittsburgh, Pa.
4. A progress report on the *N. S. Savannah* will be given jointly by P. P. Eddy and K. W. Hess, Nuclear Projects Office, Washington, D. C.

In a second environment session, of which Merrill Eisenbud, New York University, is chairman, three papers are now scheduled:

1. Local Problems in Regulation, by Hanson Blatz, of the New York City Health Department.
2. State Food Problems, by Leonard Menzer, of the Hartford City Health Department, Hartford, Conn.
3. Needs for Uniformity in Laws.

In addition, a representaitve of the United Nations will speak on International Problems in Radiation.

A third environment session, having to do with water supply and waste disposal, will be headed by E. Shaw Cole, F. ASCE, the Pitometer Associates, with R. E. Furham, F. ASCE, Federation of Sewage and Industrial Wastes Associations. Four subjects will be covered:

1. Environmental Radioactivity in Large Area Surrounding Nuclear Electric Plant, by John V. Nehemias, director of Radiological Health Surveys of the National Sanitation Foundation, University of Michigan.
2. Strontium 90 in Surface Waters will be covered by C. P. Straub, L. R. Setter, and P. F. Hallbach, Department of Health, Education and Welfare, Robert A. Taft Engineering Center, Cincinnati, Ohio.
3. Use of Tritium as a Tracer in Evaluating Waste Discharges, by Warren J. Kaufman and Richard M. Hours, University of California, Berkeley.
4. Hanford Reactor Effluent Contribution to Environmental Radiation Dose, by Robert L. Junkins, General Electric Co., Richland, Wash.

James G. Terrill, Jr., acting chief of the Division of Radiological Health, is representing ASCE on the Program Committee.

NSF Offers Travel Expenses To Tokyo Earthquake Congress

Scientists and engineers who will be taking part in the Second World Congress on Earthquake Engineering—set for Tokyo and Kyoto, Japan, July 11-18, 1960—are urged to get in touch with the National Science Foundation, which is making grants available to defray partial travel expenses of a limited number of U.S. participants. Efforts will be made to have the grants approximate round-trip air-tourist fare between the scientist's home institution and Tokyo.

Application blanks may be obtained from the National Science Foundation, Division of Mathematical, Physical and Engineering Sciences. Completed application forms must be submitted by April 30, 1960.

Let's Finish the UEC Drive for Funds

This is the start of a momentous year in ASCE history. It is the start of the year in which member giving for the United Engineering Center will be completed—early or late. With New Year's the time for making good resolutions, the 32,765 ASCE members who have not yet contributed to the UEC financing campaign cannot do better than resolve to make a contribution—however modest—and then carry out their resolution.

Up through the week ending December 11, only 11,670 members of the Society—slightly over a quarter of the membership—have contributed $661,-833, or 83 percent, of ASCE's alloted quota of $800,000. Though this is an impressive accomplishment, we must not lose sight of the fact that a matter of some $140,000 still stands between us and our goal. The earlier this obligation is met, the faster the Society can get on with its work.

As will be seen on the accompanying chart, ASCE is second among the original four Founder Societies in the race to complete quotas. AIEE is in first place with 89 per cent of its goal achieved; both ASME and AIME are trailing ASCE. The American Institute of Chemical Engineers, the fifth Founder Society, met its quota months ago.

In the Local Sections

Once again the big news in the campaign is what the Local Sections are doing. Since the last (December) issue went to press, three more Sections—Alaska, Central Illinois and Virginia—have attained the UEC Honor Roll, bringing the total to thirty. A generous $6,270 contribution from a former president made it possible for the Virginia Section to jump dramatically from the half-way point and join the 100 percenters. Though the Southern Idaho Section was among the first to make its goal, it has quietly gone about collecting more money and at the moment stands at an impressive 174 percent.

Before going over the top, the Alaska Section voluntarily increased the size of its quota by $1,000. As in the case of the Hawaii and Puerto Rico Sections, its victory is all the more impressive because of its distance from the new Center.

Subcontract Awarded

Groundbreaking for the UEC took place in October, and excavation for the foundations is now underway. The contract for the foundations has been awarded to the Thomas Crimmins Contracting Company, of New York City. It will be recalled that the general contractor is the Turner Construction Company; the structural engineers are Seelye, Stevenson, Value & Knecht; and the mechanical engineers, Jaros, Baum & Bolles.

The new building—an eighteen-story tower of glass, metal, and limestone, rising from a two-story base—will have a net area of 179,885 sq ft, almost twice the space available in the present Engineering Societies Building. Its facilities will include a 450-seat auditorium, ample accommodations for the Engineering Societies Library, and several restaurants.

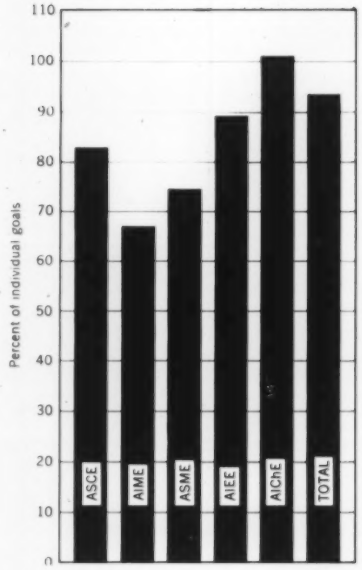


Fig. 1. Member giving for United Engineering Center as of December 11 shows that ASCE has attained 83 percent of its goal. Total member giving is 94 percent completed.

Big shovel is seen excavating at UEC site on United Nations Plaza as subcontractor begins work on foundations. Completion of the 18-story building is planned for mid-1961.

President Marston's Letter

In case President Marston's recent inspiring letter to the membership was overlooked in the heavy Christmas mails, it is quoted here:

"We are entering the closing phase of one of the most ambitious and worthwhile projects ever undertaken by ASCE—the raising of $800,000 in voluntary membership gifts toward financing the new United Engineering Center. To date, less than one-third of our members have responded to pledge more than 80 percent of that total.

"The purpose of this message is threefold:

"1. To those who have supported the campaign with their efforts and their pledges, I wish to express deep thanks and appreciation. But their greatest reward will not be in words of gratitude; it will come in the pride they have a right to assume in the Center when it is completed.

"2. For those who have given, the pledge card is not intended. But if they wish to supplement the pledges they have made, they are invited to use the

cards for greater participation in this worthy cause.

"3. To the more than 30,000 members who have not yet participated, this is an appeal for their contributions.

"Although personal solicitation of every member was the aim of the campaign through the Local Sections, it is probable that thousands were not reached by a solicitor. The pledge card below will provide every member an opportunity to have a personal share in the new building. Please use the addressed envelope at right for mailing the pledge card bearing your signature and the amount of your pledge.

"This is your opportunity to join with your fellow engineers in this united effort to bring the new building into reality. ASCE needs your help in maintaining its leadership in the advancement of our great profession."

A convenient pledge card showing members how to subscribe over a three-year period accompanied President Marston's letter. Members who have not already made a contribution are urged to fill out their cards and return them promptly.

Campaign in ASCE Sections

Local Section	Quota %	Local Section	Quota %
The Champs!			
South Idaho	174	Central Pa.	108
Philadelphia	144	Delaware	105
Cincinnati	141	Maryland	105
Indiana	137	Metropolitan	105
Lehigh Valley	136	Tenn. Valley	105
Columbia	131	Georgia	104
West Virginia	124	Wisconsin	104
Kentucky	123	Connecticut	103
Rochester	123	Central Ohio	103
Ithaca	121	Nashville	103
Hawaii	119	Central Illinois	101
Puerto Rico	115	Alaska	100
Tri-City	112	Maine	100
Kansas City	109	Rhode Island	100
Arizona	108	Virginia	100
Down the Stretch			
Nebraska	95	Sacramento	75
Syracuse	95	Panama	74
Iowa	94	Spokane	74
San Francisco	91	St. Louis	72
Illinois	90	Seattle	71
Tacoma	86	Kansas	70
Massachusetts	82	Mid-Missouri	70
Texas	80		
Gaining Speed			
Oklahoma	69	Dayton	63
Pittsburgh	69	North Carolina	61
Buffalo	68	Mid-South	60
Duluth	68	Akron	57
Cleveland	65	Mohawk-Hudson	56
First Gear			
Toledo	54	Venezuelan	47
Los Angeles	53	Wyoming	47
Nat'l. Capital	52	Miami	45
San Diego	52	Mexico	43
Montana	50	New Mexico	42
South Carolina	50	Michigan	40
Intermountain	47	Northwestern	40
Oregon	47		
Slow Start, Strong Finish?			
Louisiana	35	New Hampshire	32
Colorado	34	South Dakota	30
Alabama	32	Brazil	14
Florida	32	Rep. Colombia	10

UEC HONOR ROLL

Thirty-one Sections have now made the UEC Honor Roll, with the addition of Alaska, Central Illinois, Virginia and *Syracuse to the list. In the Districts, the news is that Districts 1 and 9 have just joined District 4 in meeting their quotas. Nearing the finish line in the Zones is Zone I, which has pledged 97 percent of its quota.

Kentucky (123)
Lehigh Valley (136)
Nashville (103)
Cincinnati (141)
Columbia (131)
Philadelphia (144)
Hawaii (119)
Rochester (123)
Ithaca (121)
Southern Idaho (174)
Indiana (137)
Delaware (105)
Kansas City (109)
Central Pennsylvania (108)
Arizona (108)
West Virginia (124)
Central Ohio (103)
Tri-City (112)
Puerto Rico (115)
Wisconsin (104)
Georgia (104)
Maryland (105)
Tennessee Valley (105)
Metropolitan (105)
Connecticut (103)
Maine (100)
Rhode Island (100)
Alaska (100)
Central Illinois (100)
Virginia (100)
Syracuse (101)

* Syracuse met its quota too late for inclusion in the UEC story.

Daniel W. Mead Prizes Presented at Section Meetings

This year's winners of the Daniel W. Mead Prizes for the best papers dealing with ethics—announced by the Board at its Washington meeting—received their awards at two Local Section meetings held in December. As noted in the November issue, the Associate Member winner is Morgan I. Doyne, civil engineer for the Ben Hur Construction Company, St. Louis, Mo., and the Student Chapter winner is L. G. McLaren, of the University of California. Both wrote on the same subject, "The Responsibility of the Employee Engineer to His Employer."

Mr. Doyne is the son of a member of ASCE—the late Max H. Doyne, director of public utilities for the City of St. Louis at the time of his death in 1943. Before going to the Hur Construction Co., Mr. Doyne was with the M. W. Kellogg Co., of New York, and Sverdrup and Parcel, Inc., a St. Louis consulting firm. He is a 1949 graduate of Purdue University and has an M.S. in soil mechanics from Purdue and an M.S. in structural engineering from Washington University.

Mr. McLaren, the student winner, will receive his B.S. degree in civil engineering from the University of California this January. His college education was interrupted in January 1955 when he received a commission in the U.S. Army and began a two-year tour of duty. Since his discharge he has been employed by the California State Division of Highways, where he now holds the position of highway engineering technician. He was granted an educational leave of absence in the spring of 1958 to return to Berkeley and complete his studies.

The prizes were established and endowed in 1939 by the late Daniel W. Mead, Past President and Honorary Member of ASCE. They consist of engraved certificates and cash awards of $100 and $50, respectively.

Morgan I. Doyne

L. G. McLaren

(Continued on page 66)

Ohio develops specifications for consulting services

E. S. PRESTON, Director, Department of Highways, State of Ohio, Columbus

Comprehensive contract "Specifications for Consulting Engineer Services" have been developed by the Ohio Highway Department to achieve uniformly acceptable results in work performed by consulting firms. Those formal specifications have been in use since April 1959, and have been quite effective in getting data presented on a uniform basis for approval or payment. Consultants have found them valuable.

These Specifications are divided into five major sections. The first two are of a general nature, and the remaining three are designed to control specific categories or phases of work. Also included in the Specifications are Appendages (see accompanying boxes) which contain forms and specific examples of the state's requirements in scheduling and reporting progress, rendering billings, etc., which serve to secure a uniformity in the preparation of consultant submissions that could be achieved in no other way.

Section 1, Definitions. This section of course serves the prime purpose of establishing a uniform interpretation of critical words and phrases. In all succeeding sections, these definition terms are italicized to alert the reader to their importance for complete comprehension of the requirements of the engineering agreement.

Section 2, General Clauses and Covenants. This section sets forth the State's requirement on those items that are common to all phases of the consultant's work. The State's requirements are established with regard to such items as "Insurance and Idemnity," "Ownership of the Work," "Transfers" (subletting of the work), "Inspection of the Work," "Reviews and Acceptances," "Appearances and Conferences" (when and if extra compensation is permitted), "Payment for Additions or Deletions" as opposed to "Changes Requiring Additional-Fee Payments," "Work Schedule and Progress Reports," "Failure to Comply With Time Schedule," "State's Option to Terminate," etc.

Typical of the contents of Section 2 is the item that establishes the State's policy with regard to "Changes Requiring Additional-Fee Payments." In the past it has been most difficult to determine when additional-fee payments are justified. It is believed the application of the following section will avoid future misunderstanding:

"The State may, upon written notice and without invalidating the Engineering Agreement, require changes resulting in the revision or abandonment of work already satisfactorily performed by the Consultant.

"The value of such changes to the extent not reflected in other payments to the Consultant, shall be determined by mutual agreement in one or more of the following ways:

"(*a*) By estimate and acceptance in a lump sum.

"(*b*) By unit prices identified in the Engineering Agreement, or upon which there is subsequent agreement.

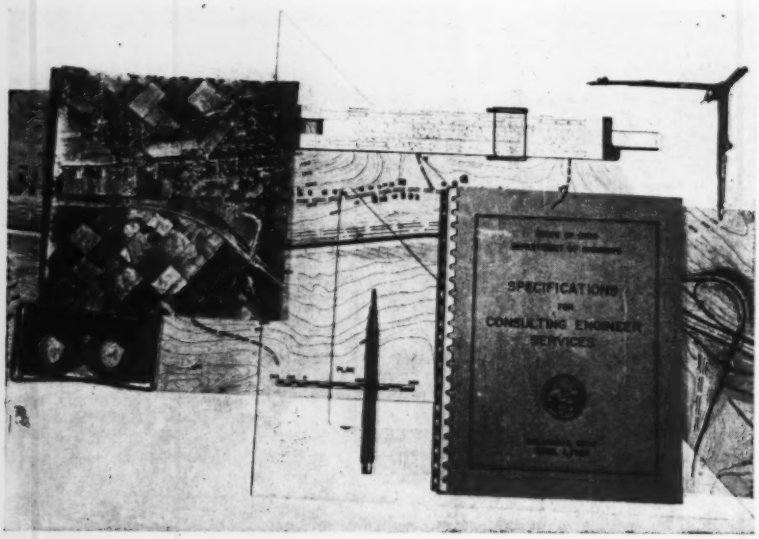
"(*c*) By cost plus one hundred (100) percent, or by cost and a fixed fee.

"The cost in (*c*) supra is defined as the actual productive salaries of the personnel employed by the Consultant who are directly engaged in the work involved, as evidenced by transcript copies of payrolls and an affidavit; fringe benefits, officers' salaries, nonproductive payroll expenditure; travel and subsistence expenses; overhead; etc.; shall be included in the percentage or a fixed fee.

"However, no changes for which Additional-Fee Payment is claimed shall be made unless in pursuance of a written order from the State, and no claim shall be valid unless so ordered."

The flexibility of the alternatives is particularly desirable, as different situations require different approaches for equitable payment.

Section 3, Preliminary Engineering Report (Arterial or Route Report). This section serves the basic purpose of providing an analysis and determination of the most feasible locations for highway facilities, between limits as identified in the engineering agree-



From "Sample Form of Engineering Agreement"

3. The Contract Sum. The State agrees to pay the Consultant for the performance of this Engineering Agreement, as follows:

Arterial Report (cost-plus or lump sum)

Preliminary Engineering Report (per mile of final alignment or lump sum)

Design Report (percentage of Tentative Construction Cost Estimate accepted in Final Report)

Construction Contract Plans (percentage of Official Construction Cost Estimate)

4. Additional-Fee Payments. The State also agrees to pay the Consultant for the performance of the following services, if such services are authorized by the Engineering Agreement, or subsequent letter-authorizations, as follows:

(a) Soil Profile (per mile of final alignment) or (provided by State)

(b) Foundation Investigations (cost-plus) or (provided by State)

(c) Checking of Shop Drawings ($.... per ton of approved pay weight of the structural steel)

(d) Preparation of Appropriation Plats ($.... per plat or cost-plus)

(e) Survey Parties:

3 Men ($.... per hr for 40-hour week, or less)
($.... per hr for hours in excess of 40 per week)

4 Men ($.... per hr for 40-hour week, or less)
($.... per hr for hours in excess of 40 per week)

Additional Survey Party Personnel ($.... per man per hour)

All survey party rates shall include all costs and expenses associated herewith.

(f) Appearances:

Principal Engineer ($.... per day)

Principal Assistant Engineer ($.... per day)

Fees established for Principal and Principal Assistant Engineers do not include allowable reasonable subsistance and travel expenses.

ment, to the accuracy necessary for the holding of a public hearing.

Past experience has indicated less uniformity in this category of work than in most others; for example, these types of reports did not give sufficient consideration to right-of-way requirements. To overcome this common deficiency, the Specifications state:

"Prepare property maps by usable sections for stage construction, preferably on aerial mosaics showing the entire existing ownership affected by the recommended route, together with the general limits of the right-of-way required and the parcel numbers for each property. A tabulation shall be included summarizing parcel numbers, names of the property owners, gross acreage, approximate acreage to be acquired and the residual acreage shown separately for each side of the highway in cases of property severance. In the event aerial mosaics are not a part of the Preliminary Engineering Report, it will be necessary to include maps to show the same right-of-way information. It is intended that this information as well as that required in a succeeding section shall be obtained primarily from the County records such as tax maps and a general knowledge of the properties affected. Most of this work can be accomplished in the office except for field review of the location which can be made in conjunction with the field trips required for other purposes."

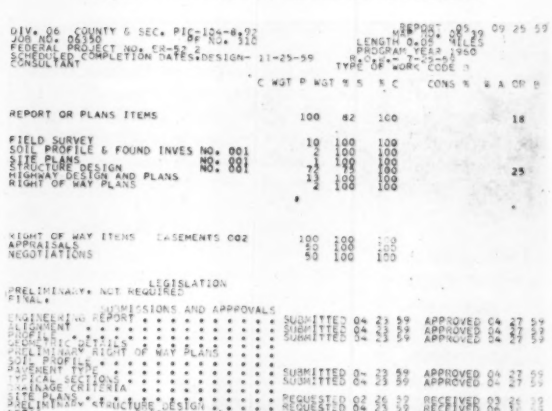
This requirement is particularly pertinent in rural relocations where large tracts are severed. On projects in urban areas this requirement may be waived if it is deemed unnecessary.

Section 4, Design Report. Design reports as such are not required on all projects. Their development is generally limited to projects passing through urban or semi-urban areas or through rural areas where construction cannot be financed immediately and right-of-way acquisition is imperative to hold the location. This section of the Specifications requires that all basic design features be resolved and that the right-of-way requirements be determined. In the event the Design Report is dispensed with, and the consultant is required to go from the Preliminary Engineering Report to the Construction Contract Plans, the provisions of this section are to be met in conjunction with the Construction Plan development.

The design report provisions require the State's written approval of fundamental design elements such as alignment and profile; proposed typical roadway sections; preliminary interchange and intersection designs; types,

EXHIBIT NO. 1

From a preliminary Engineering Project Status Report as tabulated by an electronic computer



Typical "Application for Payment"

This is to certify that the following work, for which the Consultant is responsible under Engineering Agreement No. ....., has been completed as set forth in this Application for Payment:

PERCENT OF WORK COMPLETED AS OF (date)

Item No.	Element Description	Element Weight	Percent Element Completed	Element Claimed
	Report or Plans Items	5	100	5.00
28–30	Field Survey	10	95	9.50
32–34	Soil Profile & Found. Invest.	7	100	7.00
35–37	Site Plans	3	100	3.00
38–40	Structure Design	25	80	20.00
42–44	Highway Design & Plans	45	68	30.60
45–47	Right-of-Way Plans	5	10	0.50
Totals		100%	xxx	75.60

Percent Claimed on This Application—75.00%

sizes and location of major structures; right-of-way plans; preliminary drainage design; railroad's approval of location; plans for railroad structures; foundation design recommendations for all structures; and appropriate jurisdictional approval of the proposed treatment of local roads.

Section 5, Construction Contract Plans. No attempt has been made to explain each and every design feature required for a complete and acceptable construction plan. The Specifications lend emphasis to the fact that the sole purpose of the Construction Plan is to develop and provide the State with adequate design details and related documents for receiving and evaluating comparable competitive construction bids, and to provide the contractor with sufficient details to build the improvement. In addition to the plan development requirements set forth in these Specifications, consultants are required to conform with the practices and requirements of the State's *Manual of Location and Design, Design Specifications for Highway Structures, Standard Bridge Drawings, Specifications for Subsurface Investigations, Right-of-Way Manual, Standard Construction Drawings,* and *Construction and Material Specifications.*

Discussion of the Specifications up to this point has been limited to the Consultant's obligations to the State. Conversely, the State has obligations to the Consultants, and they are recognized. For example, the Specifications require the State to expedite all reviews of the Consultant's submissions and promptly tranmit to the Consultant, in writing, the dates of acceptance for all submissions; or if a submission is not acceptable, a statement of the deficiencies to be remedied prior to acceptance. Further, the State obligates itself to processing a Consultant's billing within thirty days following its receipt. If a billing is not acceptable, the State is required to furnish a clear statement regarding its ineligibility and the deficiencies to be corrected prior to acceptance and processing for payment.

Ohio's early engineering agreements with consultants were a combination of specifications and contract forms, with several inherent disadvantages. The April 1959 Specifications correct such deficiencies and permit several innovations:

1. The contract form or document is very brief and includes reference only to variable items peculiar to each project such as: the project description, or limits; an incorporation or deletion of certain items of work, through reference to the Specifications; a time schedule, for submission of the work items; a contract sum, expressed as a lump sum, unit cost, or percentage of estimated construction cost; certain unit prices for application to any additional-fee payments such as soil profile on a per-mile basis, survey parties, preparation of appropriation plats, checking of shop drawings, etc.; and the consultant's warranty.

2. The work performance and requirements, on all engineering agreements involving the same work categories, are identical and therefore are equitable and consistent in all respects. Incidentally, the Specifications also provide an excellent check list for work performed by departmental personnel.

3. False starts and claims for extra compensation, based on incorrect or outdated assumptions or data, are eliminated by the Specifications obligation in each section for current written State approval of existing data and information upon which the new work is predicated.

4. Monthly payments for consulting services may be based on the consultant's percentage of actual achievement, as computed from items and weight factors identified in the work schedule. Furthermore the approved work schedule can be stored in the memory of an electronic computer and, as progress reports are received from all consultants at the close of a standardized report period, the computer will print a complete status report for each project. (See Exhibit No. 1).

So far our experience in the use of the new Specifications and agreement form is somewhat limited. Consultants have, however, without exception, expressed their approval. They are of the opinion we now have specific instructions that will insure delivery, on schedule, of engineering work items conforming to the State's requirements.

Ohio's Division of the U.S. Bureau of Public Roads also has approved the Specifications as a requirement on all projects assigned to our consultants where federal participation is expected in preliminary engineering costs.

We realize that Ohio's "Specifications for Consulting Engineer Services" will require revision from time to time to keep them up-to-date. For example we are now developing a completely new section to control the development of Urban Thoroughfare Reports. However, much has been accomplished in Ohio towards improved contract relations with consulting engineers.

Note: Ohio's revised "Specifications for Consulting Engineer Services" can soon be obtained from State of Ohio, Dept. of Highways, Columbus 15, at $1.50 per copy.

In Our Sister Societies . . .

Another step toward bringing cheap nuclear power closer to realization was revealed in a paper presented at the annual meeting of the **American Society of Mechanical Engineers,** held in Atlantic City early in December. The paper, outlining a new way of containing a nuclear reactor in order to guard against possible explosion, was written by two California engineers—C. C. Whelchel, of the Pacific Gas and Electric Company, and C. H. Robbins, of the General Electric Company.

Essentially, their proposal is to eliminate the huge metal domes that now surround nuclear power plants by substituting a pool of cold water and a much smaller dome. In addition to cutting costs and helping to make power more economical, this would reduce any possible hazard from escaping fission products. In the event of a leak the steam, hitting the cold water, would condense almost immediately, thereby eliminating the need for the big expensive dome.

The paper was based on a research program suggested by the General Electric Company and financed by the Pacific Gas and Electric Company. Copies of the paper, identified as No. 59-A-215, are available on request at 80 cents each from the Order Department, ASME, 29 West 39th Street, New York 18, N. Y.

Engineers more than other professionals are equipped to bridge the gap between technological and social progress. This was the substance of the response by Dr. W. R. Marshall, of the University of Wisconsin, upon receiving the Professional Progress Award at the recent annual meeting of the **American Institute of Chemical Engineers** in San Francisco. The engineer can do this, he said, because his professional activities are concerned with the wise and economic application of the basic sciences for the "progressive well-being of mankind."

Dr. Marshall also urged engineers to play more of a part in national affairs "in order to ensure a better understanding of technology and to help in forming more efficient national engineering policies."

highway bridge practice . . .

GLENN S. PAXSON, F. ASCE, Assistant State Highway Engineer, Oregon State Highway Department, Salem, Ore.

New welding techniques . . . high-tensile-strength bolts . . . composite construction . . . precasting of bridge members . . . these and many other recent developments in highway bridge practice have resulted from the impetus given to highway construction by the Federal Highway Act of 1956. These developments would have come, in time, without this impetus, but the volume of structural work in the expanded highway program has materially hastened them. This is particularly true of the Interstate System with its many interchanges and separation structures.

The standards for the Interstate System give preference to structural types requiring no supporting members above the roadway surface. This is a wise provision and is just as valid for the primary, state secondary and farm-to-market roads as for the new Interstate System. One result of this preference has been the almost complete disappearance of the through steel truss, so common in earlier highway work. At the same time the insistence on smooth, easy grade lines has usually limited the depth of the superstructure to the practical minimum so that the required vertical clearance could be provided. To meet these conditions, girders with longer spans than were previously considered economical are being used.

There is a limit to the span lengths that can be reached with rolled shapes such as wide-flange beams. Beyond this length a built-up girder is required. The development of welding techniques in recent years has materially improved the position of this type of structure, from both the economic and the structural standpoint. The heavy cover plates are attached directly to the web plates, without the flange angles used in a riveted girder. A single thickness of flange plate can be used. There is no deduction in area for rivet holes and the metal can be placed in the location where it is most effective.

Fabrication of large welded girders has necessitated major retooling in the fabricating shops. Jigs have been developed to hold the plates in line and to cant or turn heavy members so that down-hand welding can be used with continuous automatic submerged arc methods. Special electrodes best suited to each type of steel have been developed.

Welded construction presented a rather difficult selling job to its proponents before it became generally accepted. There is no easy inspection procedure that will give complete assurance of high-quality welds. This problem has been solved, at least partially, by the use of X-rays or radiation inspection techniques. By these methods, pictures of important weldments can be obtained and the quality determined without destroying the weld. Such inspection can easily be done in the shop, but is difficult to do in the field. A practical method of inspection for field use has yet to be developed.

Welding is not confined to plate girders. Members of trusses or arches are now commonly built up of plates with considerable advantage over structural shapes. The section can be planned to place the metal in the position to give maximum use.

Field erection of steel structures has been simplified by the development of high-tensile-strength bolts. Their use has proved particularly advantageous for field splicing of welded girders. It is not uncommon to find steel-erection projects without a single riveting crew on the job. The use of bolts is not confined to the smaller jobs. A good example is the Carquinez Straits Bridge in California, a major cantilever bridge, in which high-tensile bolts were used in the main connections.

Composite construction, combining wide-flange beams or plate girders with a concrete deck, has become common —the steel in tension and the concrete in compression, both working in the most advantageous way. The welded-stud shear connector is a recent development that has done much to popularize composite construction. The AASHO Road Test now in progress is using several composite structures. While a detailed report on the bridges must await the completion of the tests and the analysis of the data, the added toughness of composite construction is evident. [A report on the current status of the AASHO Road Test appears on page 35 of this issue.]

More economical use of composite action will result if a new section is developed to supplement the now available symmetrical wide-flange beam. In composite construction the neutral axis of the section is in or near the top flange of the beam, where but little use of the metal can be had. Suggestions have been made to steel producers explaining the advantages of an unsymmetrical section with only enough top flange to permit the attachment of shear connectors. As demand increases, such a section will unquestionably be produced.

Probably the most spectacular advance in short-span bridge practice in recent years has been the development of precast, prestressed and preten-

. . . new developments spurred by highway program • new welding techniques • high-strength bolts • composite construction • electronic computers •

Above, flange is welded to web of large plate girder to be used by the California Division of Highways. At right, prestressed concrete girders are in place on the concrete-pile substructure for the Third Bay Bridge near Tampa, Fla. Girders are the AASHO-PCI standard section made in the manufacturer's plant. Diaphragms will be poured in place on top of the girders.

sioned concrete girders, slabs and channels. This type of construction is rapidly gaining favor, not only for bridges, but for buildings. The manufacture of these members is a factory operation and requires a considerable investment in plant equipment and facilities. Volume production and the repeated use of forms, tension beds, and stressing equipment has reduced the cost until these members are in a very favorable competitive position in some areas. As more plants are built, the use of precast, pretensioned, prestressed superstructure members will increase until their consideration as an alternate to steel beams or girders will become the common practice.

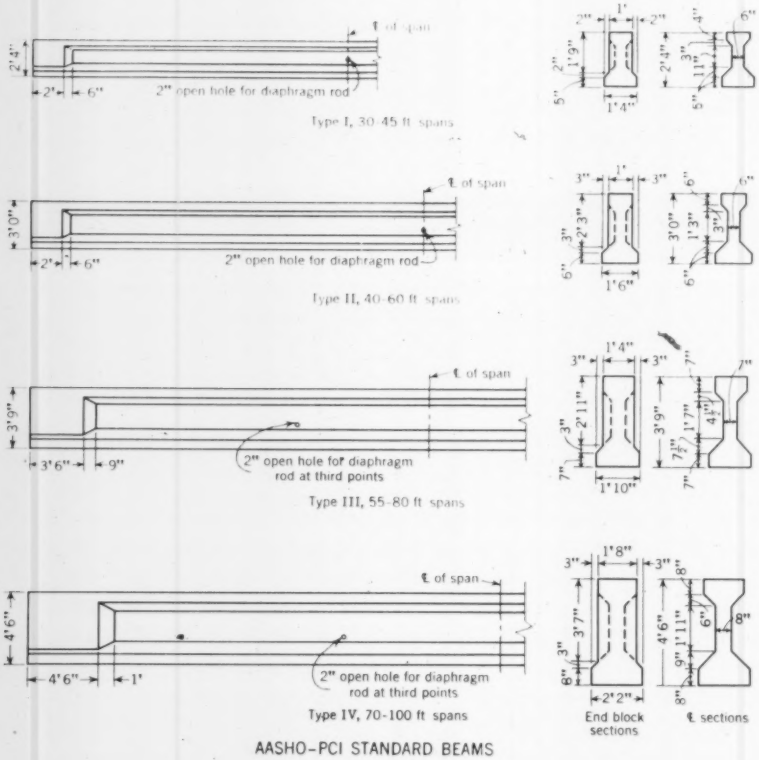
Precast concrete has found its major use in the form of the I-section girder with a cast-in-place deck. The deck forms are supported from the girders, eliminating falsework. Adjustments in deck thickness give an opportunity to correct variations in the camber of the girders. The cast-in-place deck avoids longitudinal joints and can serve as the roadway surface without an asphaltic wearing course. Slabs and channels have found their greatest use in replacement operations where the minimum delay in returning the structure to use is of paramount importance.

Construction of this type has been used in span lengths exceeding 100 ft. The length limit depends almost entirely on the availability of equipment to haul and place the girders. Some experimenting is being done with lightweight aggregates and a weight reduction of at least one-third can be realized. This would increase the practical span lengths considerably above those now in general use.

The greatest use of precast concrete has been in the southeastern states where the topography requires a large number of long structures made up of repetitive short spans. An accompanying photograph shows a construction view of the Third Bay Bridge near Tampa, Fla.

Volume production and re-use of forms are the key to economy. This can best be accomplished by the maximum practical standardization. Recognizing this, the Bridge Committee of the AASHO and the Prestressed Concrete Institute, through subcommittees of each organization, has produced a series of standard plans for I-beams and slabs and proposes soon to develop

FIG. 1. Standard prestressed concrete I-beams as designed by a joint AASHO-PCI committee.



AASHO-PCI STANDARD BEAMS

a standard for channel sections. Like all standards, these are compromises. An individual design for any one project might show slight savings in material, but the material itself is a relatively small part of the final cost. The advantages of standardization outweigh any savings in material. The standard plans for I beams are given in Fig. 1.

Longer spans are of course practical for post-tensioned prestressed structures but the high cost of on-the-job labor has limited the use of this type. It has been used however for a number of structures with span lengths considserably above the practical limit of precast pretensioned beams. Post-tensioned box girders are particularly adaptable to overcrossing structures where headroom is limited and a smooth undersurface is wanted.

All bridges require provisions for expansion and contraction with changes in temperature. In short-span structures, the number of such devices that are required brings the cost to an appreciable percentage of the total construction cost. Until a few years ago, these devices were of metal, usually requiring machining to give true and smooth surfaces. Devices of steel give trouble from corrosion, and those of bronze, especially the self-lubricating type, are costly.

Elastomeric pads have been used for some time in the oil drilling industry, to accommodate movements comparable to those of bridges. Starting in Texas, the use of elastomeric pads, generally of Neoprene, for bridge bearings (both at the expansion and fixed ends) has become common. Their use in the United States has been confined to span lengths in which a single thickness would provide for the movement. Some experimentation has been done, mainly in Europe, with multiple-layered pads allowing for the greater movement of longer spans. The physical properties of such pads and their limitations in use have not been fully determined as yet, but tentative specifications are available which, although probably ultraconservative, have stimulated their use. The most important unanswered question at present is the effect of the extremely low temperatures in our northern regions on their durability. Trial installations in the northern states and in Canada should soon provide an answer. Experience thus far confirms their adequacy for the usual type of installation. Both their cost and their ease of installation indicate that their use will increase.

A trend that the older generation of bridge engineers see with sadness is the almost complete abandonment of arch construction. Arches, either of steel or concrete are without question one of the most beautiful bridge types. Arches are tailor made. No standardization is practicable. The ratio of man-hours of labor to units of construction is high, either in the shop for steel fabrication or on the job for concrete. Present-day wage rates have priced this type of bridge almost entirely out of the market. It is predicted that only very favorable topographic conditions will permit its use in future construction.

The trend in bridge design, as in architecture, is toward simplicity. Plain surfaces and straight lines have largely superseded the ornamentation so common in earlier structures. In general, this is good. A bridge is primarily to carry traffic from here to there, yet perhaps functionalism can be overdone. Perhaps in our worship of efficiency and utilitarianism we are neglecting the properties of our materials, paticularly concrete, by not moulding them into more pleasing shapes. After all, the structures we build today will still be serving many years from now.

No discussion of developments in highway bridge practice can omit mention of the increasing use of high-speed electronic computers. These machines have relieved the designer of many hours of tedious manual computation. The programming of many structural problems is quite difficult and complicated. Once accomplished, the programs can be re-used in the design of many structures. They can be exchanged among organizations so that no one organization need incur the cost of programming every problem. The U.S. Bureau of Public Roads is accumulating a library of programs that will soon be complete enough to meet almost every need. By taking advantage of this library our rather meager manpower can be used to maximum advantage.

In this discussion little has been said of developments in long-span bridge practice. Such developments, being more spectacular than the little things for the little bridges, has received publicity in the technical press. The smaller bridges, because of their greater number, however, account for the major part of structural highway expenditures. It has seemed worth while to point out a few of the recent developments occasioned by the accelerated highway program.

ESPS Offers New Service

A new service to employers and employees is offered by the Engineering Societies Personnel Service. Effective December 1, a free bulletin of "Engineers Available" is being distributed to several thousand employers in the Eastern states. The new bulletin, which is part of an expanded program designed to increase the effectiveness of the Service, contains short synopses of the careers of engineers who have registered with the Service and are seeking new positions. Later the new publication will be extended to cover the Midwestern office (29 E. Madison St., Chicago) and the Western office (57 Post St., San Francisco.).

Any employer interested in receiving the bulletin should so advice ESPS at 8 West 40th Street, New York 18, N. Y. Similarly, any engineer who is registered with the Service or who wishes to register with it is entitled to a 35-word notice in the bulletin. The applicant's qualifications will be brought to the attention of potential employers without revealing his identity. Forms may be obtained from the New York office.

ESPS reports that the present employment market for engineers is active, with a wide range of positions available in management, operation, design, research, and sales.

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*1960 contest closes May 1, 1960. See 1959 Official Register, page 143, and July 1959 issue of CIVIL ENGINEERING, page 66.*
FREEMAN FELLOWSHIP:	*1960 contest closes April 15, 1960. See Official Register, page 154.*
ERNEST E. HOWARD AWARD:	*Closing date Feb. 1, 1960. See Official Register, page 142.*
J. WALDO SMITH HYDRAULIC FELLOWSHIP:	*1961-62 (closing date pending). See Official Register, page 156.*

NEW EQUIPMENT ——on our highways

H. A. RADZIKOWSKI, Chief, Division of Development, Office of Operations

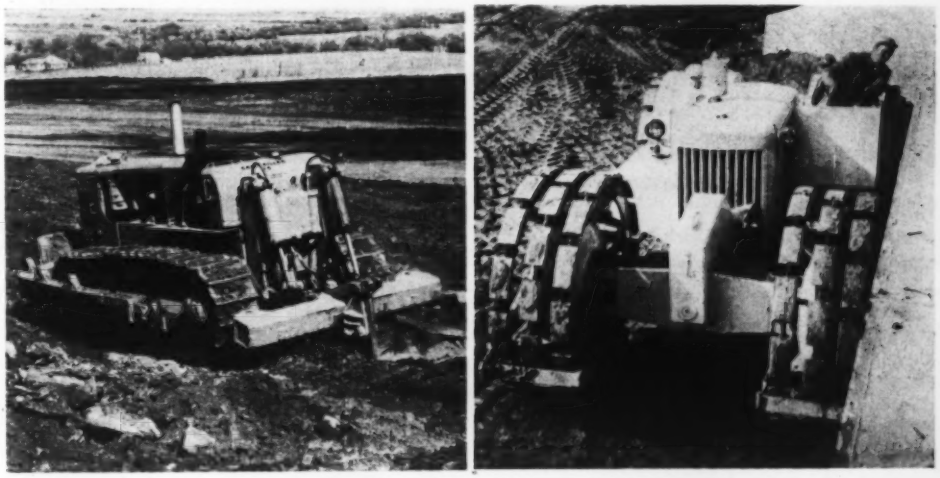
Bureau of Public Roads, U.S. Department of Commerce, Washington, D. C.

Many efforts are being made to keep the cost of constructing the Interstate Highway system as low as possible. Equipment manufacturers are making a major contribution to these efforts by developing new and more efficient machines. Highway design and construction engineers need to be well informed as to the potentials of such machines so that they can utilize them in securing a high quality of work and maximum economy. A visit to a typical Interstate project will reveal many equipment units in operation that had not been envisioned five years ago.

Recent developments in land clearing permit the preparation of timbered rights-of-way at only a fraction of the cost required a few years ago. A clearing blade, mountable on a large crawler tractor, literally shears off a tree trunk at stump height or flush with the ground. If the trunk is too large to be cut off in one piece, it can be readily split into shearable sizes with a sharpened prong called a "stinger." Both the shearing edge and the stinger are knife sharp. The land clearing device can also be used for stump removal, stacking, ditching and topsoil removal.

Only recently a Virginia contractor developed a huge stump axe, which is especially valuable where the tree trunks can be utilized as merchantable timber. A large pivoted cutting knife, which resembles the blade of a brush hook or woodsman's knife, is mounted on a special power-shovel front and has the action of a backhoe. The axe shaves away the stump in 4- to 6-in. slivers, which can be aerated and burned in a matter of days. Stumps removed by other methods normally require a considerable area for disposal and years for decomposition. This equipment is

Below, push-loading scraper is teamed with a 600-hp wheeled tractor. Note size of tires. Compactor, at right, can employ three types of compactive effort or a combination of two types, for more effective action.



Hydraulically controlled rippers, near right, are capable of breaking up rock, shale and frozen ground which formerly required blasting. At far right, a roller of segmented-pad type compacts fill close to a culvert.

reported to be capable of removing stumps of 3-ft diameter in from two to three minutes and those of 6-ft diameter in less than ten minutes. The usefulness of this unit is not confined to forested areas; it was recently employed to advantage on a street widening project in Washington, D. C., where stump removal was involved.

Earth-moving equipment

Perhaps the most noteworthy advances in equipment development have been made in the earth-moving field, where there is the greatest opportunity for mass production. A factor that undoubtedly has stimulated machine development in this area is the absence of fixed equipment or procedural requirements, at least for the dirt moving itself. There are no fixed requirements that stipulate the kind of equipment that shall be used for the digging, pushing or hauling of earthwork.

One of the most significant developments in the earth-moving field in the past several years has been the rear-mounted tractor ripper. With total tooth pressures of four or five times those of old pull models, these rippers are capable of breaking up rock and shale strata that formerly required extensive drilling and blasting. These hydraulically controlled rippers are also capable of penetrating relatively deep layers of frozen material, thereby keeping excavation going for a much longer season.

A problem involved in the bidding on many earth-moving jobs is the determination of how much of the subsurface rock can be processed with heavy-duty rippers and how much must be drilled and blasted. Several devices are now available for making this determination from readings taken on the surface. One is the earth-resistivity equipment developed by the Bureau of Public Roads; another is a highly portable seismic device that measures the speed of impulses set up by the blow of an 8-lb hammer on a steel plate placed on the surface of the ground.

Speed and capacity are prime requisites for hauling equipment. These features are well exemplified in the modern hauling scraper powered by pneumatic-tired prime movers, which can be loaded at rates of nearly a cubic yard per second, operated at hauling speeds up to 25 miles per hour, and steered effectively on tight turns with full hydraulic power. Most of the new scraper combinations have an increased engine horsepower, hauling speed, and bowl capacity. Pay loads of 30 cu yd are now commonplace, and one manufacturer is producing a scraper combination capable of hauling pay loads up to 48 cu yd (a 38-cu yd struck rating). The hauling unit is a 600-hp wheel-type tractor.

The trend toward larger hauling units and higher operating speeds has required parallel developments in earth-moving tires. One new tire is nearly 10 ft in diameter and about 4 ft wide and holds over 5 cu yd of air or liquid ballasts. In addition to developing these huge earth-mover tires, the tire and rubber industry has provided major improvements in the tires previously available, including tires built with steel cord instead of fabric, which are expected to provide as much as three times the present normal tread life.

Compacting embankments

Newer equipment for embankment compaction falls into four main categories:

1. Self-propelled segmented-pad rollers
2. Dynamic compactors (principally of the roller type)
3. High-pressure pneumatic-tire rollers and compactors
4. Self-propelled grid rollers

The segmented-pad type of compactor includes both the functionally designed machines and the compactor wheel attachments for wheel-type tractors. The segmented-pad rollers function best in fine grained soils where tamping rollers are normally used. In addition to high-speed compaction, another reported advantage of this type is its ability to keep the embankment surface well sealed against water, thereby permitting the early resumption of grading operations after a rain.

Vibratory rollers, principally of the towed type, have been used for some years on embankment materials that are subject to consolidation by air-void displacement. Some of the newer models are high-production machines 6 ft and more in width.

Compactors of the towed type, employing a ballast of 50 to 100 tons and high-pressure tires, have been used for some years for embankment compaction and for proof rolling. The equipped with high-pressure tires have a wide range of compacting ability for new self-propelled pneumatic rollers

different types of soil because the tire contact pressure can be varied to a considerable extent.

The grid roller is not a new compacting device, but some new models have been introduced recently, including a two-drum self-propelled machine. This dual-drum unit, which employs grid rolls as the driving wheels of a four-wheel tractor, has operating speeds that range from 5 to 15 miles per hour.

Subgrades and base courses

With the continual increase in the speed of the vehicles that use the highways, a smoother pavement profile is needed. Since all pavers operate directly or indirectly on a prepared base or subgrade, the profile of this base course must be controlled to nearly the same degree of accuracy as the wearing course.

There is an electronically controlled fine-grader attachment for a motor grader that provides considerable assistance in constructing smoother base courses and subgrades at faster rates while at the same time reducing the amount of grading stakeout by at least 50 percent. It also enables the crowning of road-mix surfaces with greater accuracy. This device maintains the grader blade in a level position, or to a desired crown slope, without interference due to irregularities encountered by the grader wheels. Long-wheel-base planers, originally designed for land-leveling purposes, are also used to obtain greater smoothness in profile and cross-section. Wheel bases of 40 ft or more are employed on such machines, which are equipped with full hydraulic controls for the blades.

Base compaction is an all-important construction function. If the base contains fine-grained materials or is stabilized with binding agents, the self-propelled pneumatic roller with tire contact pressures of 80 psi and higher will obtain the desired density with the fewest passes. If the base materials are fully granular or of the macadam type, dynamic compactors will be most effective in reducing air voids, which may later permit settlement under the vibration of heavy truck traffic.

Shoe-type vibrators are among the types of compactors that have been found efficient for macadam base courses. The newest unit of this type is a large self-propelled compactor with two transverse banks of vibrating shoes 15 ft wide; it is capable of obtaining the desired density in one or two passes with a claimed hourly capacity of 1,500 tons of crushed rock with screenings. Another effective compactor for macadam bases is the three-wheel steel roller with trailing shoe-type vibrators.

A number of new and valuable improvements have been made in nearly all types of equipment used for mixing and processing bituminous materials for flexible pavements. An outstanding trend is toward automatic controls and the elimination of human error in the batching plant. With the use of electric and hydraulic controls and timing devices, one man can start the process and watch the plant go through the various cycles of automatic batching, dry mixing, weighing, the introduction of asphalt, wet mixing, and the discharge of the mix into trucks.

In the field of volumetric control and continuous mixing, the trend appears to be toward plants that will produce a larger hourly tonnage. This type of plant, because of its design, is practically automatic in operation. Controls that automatically stop the proportioning and mixing operation when the supply of one size of aggregate is insufficient, are readily available on this type of plant as well as on the batch-type plant.

Bituminous pavers

One new crawler-model paver is equipped with an electric vibrating screed that operates at 3,600 vibrations per minute. This feature, it is claimed, permits higher operating speeds because of the reduced tendency to create voids or "pull" the mat. The transmission has 15 paving speeds varying from 11 to 102 fpm and a maximum travel speed of 2.2 miles per hour. This unit is reported to have operated successfully at speeds up to 58 fpm on binder courses.

Several years ago a pneumatic-tired paver was placed on the market, and the original model has since undergone several improvements. The larger of two current models has a hopper that will hold 10 tons of mixed materials. It is reported capable of laying material in widths of 8 to 16 ft at speeds up to 62 fpm. Travel speeds up to 7 mph are possible. Some of the improved features are a long wheel-base, air-actuated controls and brakes, dual screed heaters, an automatic joint-matching device that brings the grade of the lane being placed in exact conformity with an existing course, and automatic control of the feed conveyor from the hopper to the screed to assure that the exact amount of material is furnished.

In compacting asphaltic concrete, the present trend is to follow the breakdown rolling with a self-propelled pneumatic roller capable of exerting contact pressures of 80 psi and higher. It has been found that the 50 to 60-psi average contact pressure exerted by steel-wheel rollers is well under that imposed by heavy truck tires (about 70 psi). There is also a trend toward the use of high-pressure truck tires including long-life steel-fabric types that exert gross contact pressures up to 90 psi. This development may lead to a need for even greater pneumatic-roller pressures if rutting in wheel tracks from channelized traffic is to be avoided.

Concrete paving

The modern slip-form paver is a relatively new and far-reaching development in the concrete paving field. Several types have been developed in the last decade, but only one model has undergone continuous improvement, which appears to assure its widespread acceptance.

Ordinarily when a paver for concrete pavements is mentioned, the reference is to concrete mixing equipment only. Now a concrete lay-down machine is available that performs the same function as a bituminous paver-finisher. The slip-form paver is essentially a single-pass machine that combines spreading, vibrating, tamping, finishing and belting in a single-pass operation and, in addition, hauls its own forms from which a ribbon of dense concrete is extruded. The stability of the newly poured concrete prior to initial set is due to the simultaneous application of vibration and compression to a closely controlled harsh mix.

The one-man-operated slip-form paver not only eliminates the forms and the equipment and manpower otherwise required for setting and pulling the forms, but also such single units of equipment as spreaders, transverse finishers and longitudinal finishers, each of which requires an operator. The slip-form paver has been used successfully both on the concrete base and on the finished pavement and has produced a surface smoothness that compares favorably with that of pavements constructed with carefully placed forms. Savings on pavement costs are in the range of $0.40 to $0.50 per sq yd or up to $7,000 per mile of 24-ft slab.

Last summer a manufacturer of concrete paving equipment introduced a triple-drum paver of 34E batch size. One consideration that prompted the retention of this batch size was the ease with which it can be integrated into the current batching and paver charging process. This triple-compartment unit has a capacity about one-third greater than that of the conventional dual-drum type.

The conventional dual-compartment pavers have also undergone a number of design improvements. Hydraulic or pneumatic controls have been added to nearly all paver functions, including steering and braking. Drum designs have been improved to achieve a more

homogeneous mix without clogging or segregation of materials. Dispensers for introducing air-entraining agents have been provided. Stub-nose skips have been devised which eliminate the possibility of introducing foreign matter into the mix from the wheels of the batch truck.

In the postwar period there has been an increase in the volume of ready-mixed concrete, both from central plants and from truck mixers. Available information indicates that over half the states are using this method of processing materials for concrete paving. In one urban state, the ready-mix yardage comprises about 75 percent of the total volume of paving concrete.

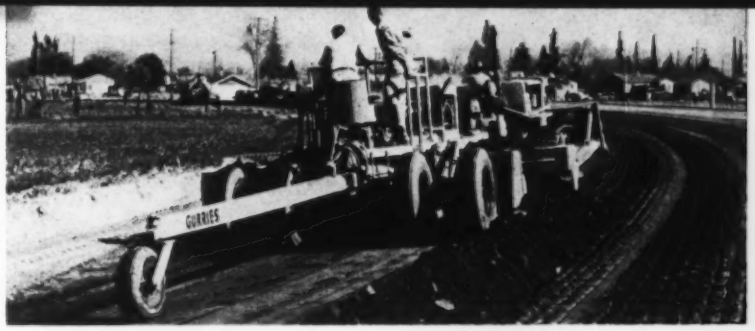
A box spreader for receiving ready-mixed concrete recently made its appearance on several concrete paving jobs, including some Ohio projects. This unit has a bottom-discharge spreader bucket operating on transverse runners, which enable it to be positioned on either side of the forms for loading. Upon loading, the bucket is moved transversely across the subgrade while it places a predetermined thickness of concrete, which can be controlled from the bucket opening. As the spreader moves forward, the adjustable strike-off screeds the concrete longitudinally. All movements of this new spreader are hydraulically powered.

Aggregate production equipment

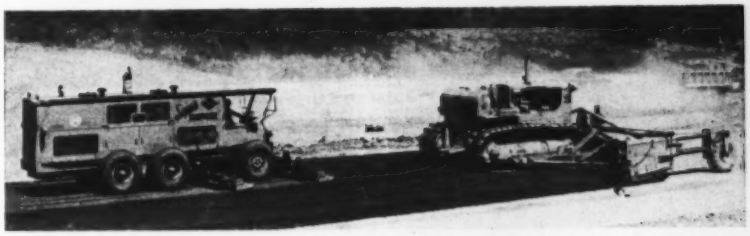
The importance of improved aggregate production cannot be overemphasized, since almost 20 percent of the on-site cost of highway construction is attributed to aggregate requirements. Just 10 years ago a production of 150 tons per hour by a portable crushing plant was considered an outstanding performance. Today a modern portable plant produces up to 500 tons per hour of better graded material. This increased capacity is due principally to the new twin-jaw crusher, which also utilizes higher crushing speeds. The increased capacity provided has made it possible to reduce the primary jaw opening and thereby to obtain a number of advantages.

Thus the ingenuity of highway contractors and equipment manufacturers is making it possible to produce better highways. Road equipment manufacturers have no intention of resting on their accomplishments. Units of equipment now in the blueprint stage or in the proving grounds will result in still further economies in the highway program.

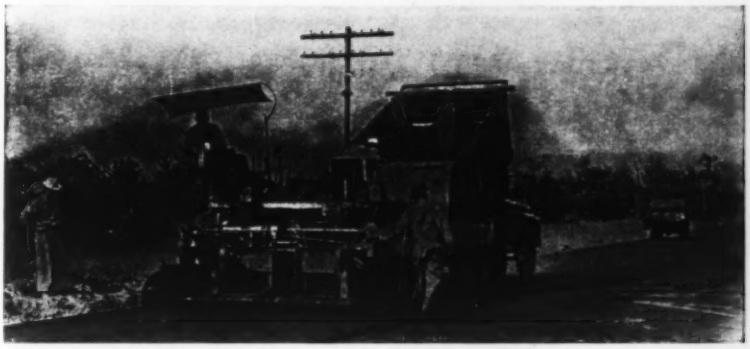
(Information on any of the equipment mentioned can be obtained by writing to the Editor.)



Fine grading is done with one of the new long-wheelbase planers.

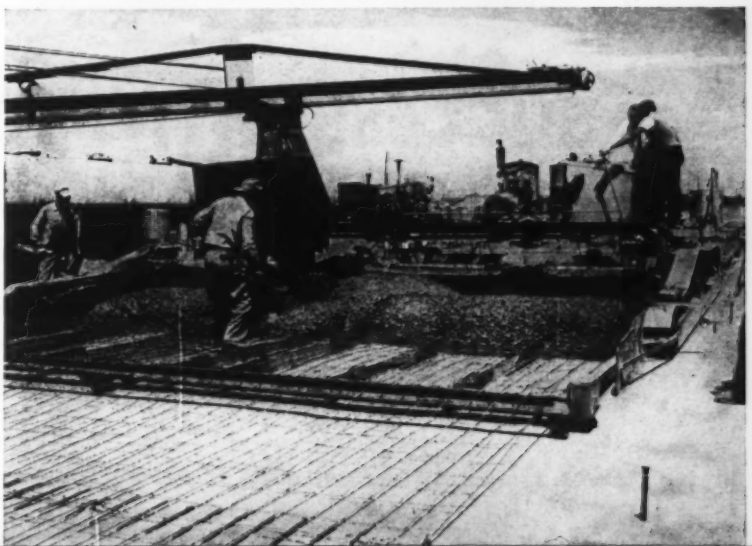


Twin-bank shoe type of compactor works behind a tractor-pushed unit for spreading base material.

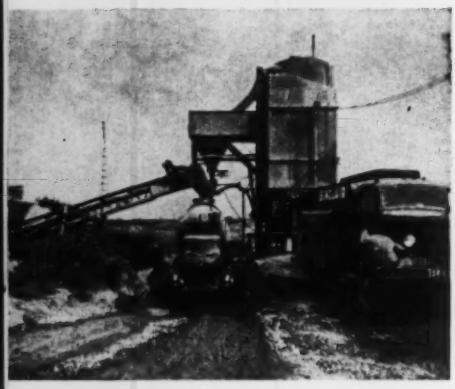


A bituminous finisher operates on pneumatic tires. It features a long wheelbase and will lay strips 8 to 16 ft wide.

Sled holds wire-mesh reinforcement at required level for one-pass operation of slip-form concrete paver.



Job-developed concrete spreader, called the Sputnik, transfers transit-mix concrete to the forms.



Sand and two sizes of stone are fed into low weigh batchers, then carried by a 30-in. belt to the truck loading hopper at the cement batcher.

All feeding to the transit-mix trucks is automatic through the panel board for batch control. Each aggregate weigh hopper has its own scale.

SUCCESS WITH A NOVEL PAVING PLANT

DOUGLAS E. SMALL, A.M. ASCE, Resident Engineer,

Wisconsin State Highway Commission

A new spreader, plus unusual use of conventional equipment, speeded paving on the Interstate Highway Route between Chicago and Milwaukee for F. F. Mengel Company of Wisconsin Rapids, Wis. A low-level aggregate batch plant, with a belt feed to transit-mix trucks, was used economically in laying 10.5 miles of wire-mesh-reinforced concrete on Route I-94 in southern Wisconsin—a total length of over 42 miles of 12 ft-wide pavement in the two dual-lane separated roadways. The new spreader was developed by the contractor for use with transit-mixed concrete.

Materials handling was arranged to provide completely automatic batching by one man—and to take advantage of the sloping terrain. Sand and two sizes of stone were hauled in from a commercial source at about the rate of use and dumped into low 40-cu yd bins, which fed to conveyors for delivery to the batch plant. Auxiliary storage of 500 cu yd of each aggregate was provided near the hoppers. Material was reclaimed by a Michigan front-end loader, delivering into the 40-cu yd hoppers.

Cement was hauled in by truck to a Rex 485-bbl bin that has an automatic

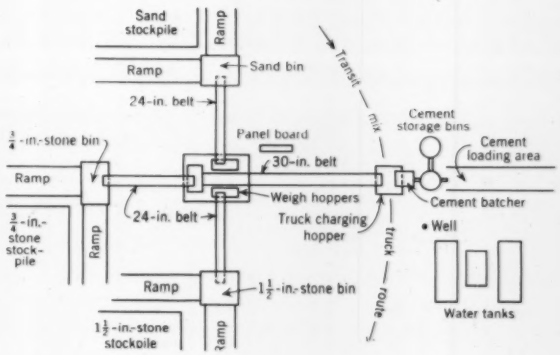


FIG. 1. Trucks back up ramp to dump aggregates into low 40-cu yd hopper that feeds onto 24-in.-wide belts for charging three automatic weigh batchers. The batchers discharge through a gated hopper to feed a 30-in.-wide belt that delivers to the transit-mix truck. Cement and water are separately batched directly into the trucks. Recovery from the 500-cu yd stockpiles at each hopper is by a Michigan front-end loader.

weigh batcher on the side, over a truck runway. Auxiliary storage was provided by a 685-bbl bin connected by a screw conveyor to the bin with the batcher. Water came from two 300-ft deep wells in the area and was stored in three tanks—two of 10,000-gal capacity and one of 3,500-gal capacity.

The plant layout is shown in Fig. 1. The weight-batch hoppers, at the center of the aggregate delivery system, operate automatically. When the weight of material in each hopper reaches the weight preset on the panel board, the conveyor belts automatically stop. Free fall of material at the time the belt stops is anticipated by a compensator on the panel board. With preset time delays the weigh hoppers open, releasing material, then close and start the conveyor belts for refilling. Compressed air is used to open and close the gates of each weigh hopper.

The most desirable sequence for loading aggregates, cement, and water into the transit-mix trucks was worked out by numerous trials and resetting of time delays. The cycle used provides satisfyingly consistent concrete, complete mixing, loading continuity, and efficiency. To obtain complete and rapid mixing, sand and stone are added in two cycles.

The sequence of loading is: 1½-in. stone, sand, ¾-in. stone, water (added during first cycle), 1½-in. stone, sand, ¾-in. stone, and cement (added after water and during second cycle). To accomplish this, aggregates were weighed through the batchers in two equal increments for the 6-cu yd batch.

One factor that contributes to consistent and efficient concrete batching is a holding device on the brakes of each truck to prevent forward and backward movement of the vehicle while it is being loaded; another is the grade where the trucks stop, which slopes downward so that the concrete materials fall more directly into the revolving drum.

Control panel board and scales

The panel board for batch control has numerous time delays and circuits. Two concrete-mix designs can be simultaneously set on the board. On this work one mix was set for the concrete pavement and the other for the concrete curb and gutter. Individual scales are connected to each weigh hopper to provide a constant check on the weights used. The amount of water can be checked by a light which flashes on the panel board as delivery is made to the truck.

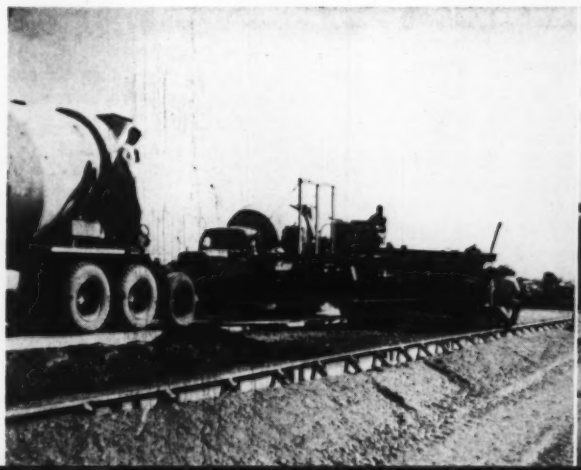
Moisture variation in the sand is kept under control by using a Mark X H_0 meter. An electrode installed in the sand weigh hopper is attached to the meter, placed next to the control panel. As the moisture in the sand varies from the desired percentage, sand can be added or subtracted by the moisture compensator, and the water meter is reset for the correct water content. This provides instant control of moisture in the batch and, consequently, control of the concrete mix.

The operator pushes one button, which starts the entire operation of loading and automatically stops it when each cycle of 6 cu yd is completed. The capacity of the plant is one truck every 1½ min or 240 cu yd per hour. Personnel at the plant consists of the plant operator, the truck foreman, and the operator of the front-end loader.

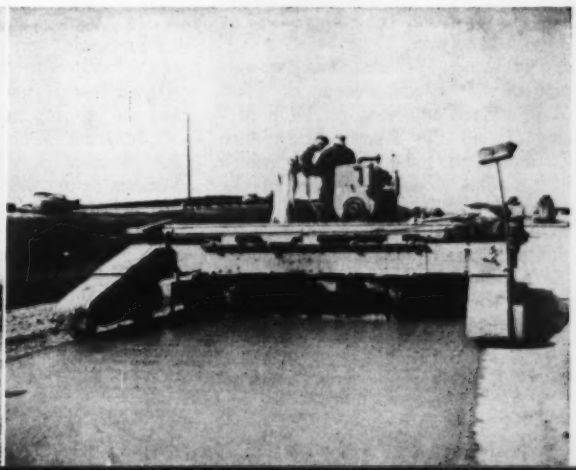
Transit-mix trucks

Eleven International trucks with Rex 6-cu yd mixers were used. Each truck is equipped with two 5-gal water tanks and a power-driven spray, which can be operated from the cab. The driver adds 5 gal to the mixer, after discharging the load, to wash the mixing blades. This helps to prevent build-up of concrete and keeps the mixer functioning properly. The second 5 gal is added after the batch is in the drum to wash the dry cement from the outer blades

Wire-mesh is in place and concrete is being placed over it to full 10-in. depth.



Rear view of finisher with pan attachment shows surface obtained with this equipment



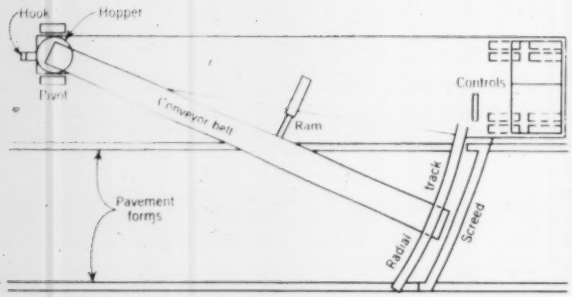


FIG. 2. Job-developed concrete spreader, named Sputnik, has a conveyor belt pivoted under the feed hopper. The conveyor is moved sideways on a radial track by a hydraulic ram to spread concrete across the 12-ft lane.

of the mixer. This method of adding water before and after loading helps to provide a better mixing of concrete yet keeps the amount of water in the mix under control at all times. The tanks and spray device were designed and built by the contractor.

Concrete paving

For ready-mix concrete, present specifications permit the paving of only one lane at a time. The contractor believes that in paving one lane 12 ft wide, the use of lighter equipment reduces vertical and horizontal movement of paving forms to a minimum, the end result being a smoother finished pavement. The entire inside lane of both contracts was completed first, then the outside lane. By hauling over the concrete pavement, after the required curing time had elapsed, the trucks were able to deliver more concrete to the spreader.

At the start of paving operations the equipment train consisted of the job-developed spreader dubbed the "Sputnik," a Blaw-Knox transverse finisher, a Rex transverse finisher, and a Koehring longitudinal finisher.

The "Sputnik"

The Sputnik, designed and built by the F. F. Mengel Company, receives, discharges, spreads and strikes off concrete to any desired depth. When a truck backs up to the Sputnik (Fig. 2) a hydraulically operated hook latches onto it so that its forward movement is controlled by the Sputnik operator. Concrete from the truck is discharged into the hopper and thence is transported on a 30-in. conveyor belt and deposited at the front of the screed. There is very little segregation of concrete as it drops off the conveyor belt in front of the screed. Concrete with 5 percent air-entrainment was placed at about a 2½-in. slump.

The conveyor belt is moved back and forth across the lane and the concrete is leveled off by the screed to a depth of 7½ in. Wire mesh is then laid on the concrete as the Sputnik moves down the roadway. After laying a 7½-in. thickness of concrete for 300 or 400 ft, the Sputnik raises the screed off the forms, backs up, lowers the screed to a height of 10 in. above the subbase and follows through, depositing and leveling concrete for the remaining 2½ in. of depth.

A 34-hp gasoline engine is used to move the Sputnik along the road. A gasoline-engine-driven generator of 25-kw capacity provides electricity to power the conveyor belt, and to operate a pump for the hydraulically operated front wheels, the hook, the mechanism for raising and lowering the screed, and the conveyor-belt ram.

Concrete finisher

After paving 24 miles of the 42 miles of 12-ft-wide pavement, a shift was made to a Rex concrete finisher with attached pan. The pan and back screed work together in controlling the amount of concrete for the pan and leave a smooth pavement for the straightedge finisher. The back screed has floating wear plates. The frame is extended behind the pan and rides on the forms, providing a leveling effect. Both the screeds and the pan float can be raised and lowered hydraulically. This eliminates the Rex transverse finisher and the longitudinal finisher, plus a couple of men. The arrangement moves more rapidly and the contractor feels that it produces a smoother riding pavement.

Using 11 transit-mix trucks and one Sputnik spreader, a maximum of 5,500 lin ft of concrete pavement 12 ft wide and 10 in. thick was laid in 11 hours. The average production rate was about 4,000 lin ft in 10 hours.

A two-way radio system connecting the plant, the paving operation, the superintendent and the project manager, was in constant use to coordinate the entire operation.

The aggregate bins were designed by William Mengel, project manager, and built by the F. F. Mengel Company. The general layout (Fig. 1) of conveyor belts, weigh hoppers and cement bins was designed by William Mengel in conjunction with the Chain Belt Company. The Sputnik was built in the Mengel shops.

New Honor for Herbert Hoover

ASCE Honorary Member Herbert Hoover has been honored again—this time for his contributions over a long period to business and professional associations. The New York Society of Association Executives presented an illuminated scroll to the former President on December 4 at his suite in the Waldorf Towers in New York. The occasion marked the fortieth anniversary of the society, whose 400 members represent business and professional groups with headquarters in New York.

Proceedings of Joint Mechanics Conferences

The importance of engineering mechanics to practically all fields of engineering is highlighted in the Proceedings of two recent conferences held at the University of Texas, with ASCE one of the co-sponsors. The two-volume set of Proceedings covers the Sixth Midwestern Conference on Fluid Mechanics and the Fourth Midwestern Conference on Solid Mechanics, which had a joint three-day session at the university. ASCE was one of thirteen technical and scientific societies participating. The sponsors also included the Air Force Office of Scientific Research, the National Science Foundation, and the Army Office of Ordnance Research.

In a foreword to the two volumes W. W. Hagerty, professor of engineering mechanics and dean of engineering at the host school, notes that "The increased use of the analytical method and the growing emphasis on design of fundamental experiments may well be attributed in part to the influence of workers in the fields of fluid and solid mechanics."

The volumes, priced at $12.50 each, may be ordered from the Engineering Institutes, University of Texas, 18th and Red River Streets, Austin, Tex.

After a comprehensive study of the Society's Code of Ethics, with special attention to the subject of contingent fees, the ASCE Task Committee on Principles of Practice submitted its final report to the Board of Direction at the Board's October meeting in Washington, D. C. The Board ordered the report published as a supplement to Manual 38, "The Private Practice of Civil Engineering." The members of the Task Committee were: E. W. Carlton, B. G. Dwyre, L. R. Howson, the late F. H. Paulson, and N. T. Veatch, Chairman.

AN INTERPRETATION OF THE

ASCE Code of Ethics

Every engineer has an obligation to conduct his relations with his employer, clients, other engineers and the public so as to enhance the honor and value of the engineering profession. The engineer in his relationship with his employer or client acts as a trusted employee and advisor whose primary objective is to serve humanity as effectively as possible and to promote the public welfare.

For the guidance of the civil engineering profession, the American Society of Civil Engineers has developed the accompanying Code of Ethics, every item of which is believed to be in the public's interest as well as in the interest of the profession.

More than a set of rules

The Code of Ethics of the American Society of Civil Engineers is the outgrowth of many years of thought, development and expression, and is a concise statement of ethical principles for the engineering profession. It is not merely a set of rules of right and wrong but rather is an expression of that refinement of character which results from habitually ethical conduct in professional matters. While the Code of Ethics does afford a basis for each individual member to judge his own conduct, it will always be the responsibility of the individual engineer to act in a manner that brings credit to the profession. However, questions sometimes arise with respect to specific ethical problems. The following illustrative interpretations are presented to elaborate upon and clarify the intent of the provisions of the Code.

In general it should be the practice of all engineers, where there is a question as to whether or not a certain procedure is ethical, to follow the course that is clearly within the limits of sound ethical practice.

Article 1 of the Code of Ethics relates to client-engineering relationships. The following are illustrative of sound ethical positions with respect to some of the questions that have arisen in the interpretation of Article 1.

It shall be considered unprofessional and inconsistent with honorable and dignified bearing for an engineer:

a. to accept compensation from any source other than his client or employer, unless with the full knowledge and consent of his client or employer;

b. to accept or pay compensation for services not rendered;

c. to represent a client where there is conflict of interest involved without fully advising the client of such conflict before accepting employment;

d. to misrepresent qualifications to clients or employers; and

e. to give professional advice or testimony which does not reflect the engineer's best professional experience and judgment.

Article 2 of the Code points out that it is unprofessional "to attempt to injure falsely or maliciously, directly or indirectly, the professional reputation, prospects, or business of another engineer."

As a further definition of this article it is unprofessional to create, even by inference, a question of the ability or integrity of another engineer. This does not, however, remove a moral obligation to expose dishonest practices or other unethical conduct.

Article 3. The Code defines as unprofessional an "attempt to supplant another engineer after definite steps have been taken toward his employment." To make this article more definitive, the following illustrations are given.

It shall be considered unprofessional and inconsistent with honorable and dignified bearing:

a. to continue to seek employment from a prospective client after being advised that another engineer has been selected subject to approval of detailed arrangements;

b. to solicit or accept employment from a client who already has engineers under contract for the same work not yet completed or fully paid for; and

c. to contact a prospective client for whom another engineer has made a study and report until and unless first being requested to do so by such client.

Article 4. It will be helpful in interpreting Article 4 if the reasons for its present wording are understood. The Code of ASCE originally read: "To participate in competitive bidding against his colleagues to secure a professional engagement which is to go to the lowest bidder." In order to strengthen this particular part of the Code, the wording was changed in 1949 to read: "To participate in competitive bidding on a price basis to secure a professional engagement."

The present wording of Article 4 was adopted in 1956. One reason for this change was the fact that it was logically just as improper for an engineer desiring to engage engineering services to solicit such services on a price basis as for a practicing engineer to submit a proposal offering services on such a basis. In some cases engineering services are solicited and engaged by members of the American Society of Civil Engineers. The present wording clearly covers both sides of the transaction.

Opinions have been expressed that adoption of the present wording represented a relaxation of the Code. This thought seems to be due to the use of

ASCE CODE OF ETHICS

It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers:

1. To act for his clients or for his employers in professional matters otherwise than as a faithful agent or trustee, or to accept any remuneration other than his stated charges for services rendered his clients.

2. To attempt to injure falsely or maliciously, directly or indirectly, the professional reputation, prospects, or business of another engineer.

3. To attempt to supplant another engineer after definite steps have been taken toward his employment.

4. To invite proposals for the performance of engineering services or to state a price for such services in response to any such invitation, when there are reasonable grounds for belief that price will be the prime consideration in the selection of the engineer.

5. To compete with another engineer for employment on the basis of professional charges by reducing his usual charges and in this manner attempting to underbid after being informed of the charges named by another.

6. To review the work of another engineer for the same client, except with the knowledge or consent of such engineer, or unless the connection of such engineer with the work has been terminated.

7. To advertise in self-laudatory language, or in any other manner derogatory to the dignity of the profession.

8. To use the advantages of a salaried position to compete unfairly with engineers in private practice.

9. To use undue influence or offer commissions or otherwise to solicit professional work improperly, directly or indirectly.

10. To act in any manner or engage in any practice which will tend to bring discredit on the honor or dignity of the engineering profession.

the words, "reasonable grounds for belief, etc." Certainly there is no justification for anyone's not knowing what these words mean, and also it was definitely the intention of the several Boards of Direction and Society committees to strengthen rather than relax this part of the Code. The records of the Society since adoption of the present wording sustain this intention.

Solicitation of bids or proposals through the medium of public advertisement or any other notice that is in essence the same thing, or submission of bids or proposals in response to such solicitation, would be a clear violation of the engineering Code of Ethics. Moreover, requests for, or submission of, proposals on forms prepared by a prospective client, where the only variable item regarding services to be rendered and the manner in which they will be carried out is that of fee, would undoubtedly indicate a situation in which price would be the controlling factor and which would not be altered by a statement that factors other than the price will be considered. In any case, the client knows whether price will be the decisive consideration, and the engineer should make every reasonable effort to determine the basis upon which the selection will be made.

Article 5. This article refers to competition for engineering employment through reduction of professional charges. It is considered fully definitive as stated in the Code.

Article 6, as stated in the Code, is also believed to be sufficiently explicit. It should however be pointed out that this article is applicable only to cases where the client requests an engineer to review the work of another engineer.

Article 7. According to this article, dignified statements, with or without illustrations, may be made regarding the professional activities of an engineer or an engineering firm for presentation to potential clients in the form of a brochure including factual information concerning the experience of the firm and its key personnel.

It is also proper for the names of consulting engineers or engineering firms to be included in a professional directory of technical or allied periodicals, provided they conform in size and character to similar listings of other professional engineers listed therein.

The insertion of display advertising in any media, offering engineering services either alone or in conjunction with advertising of construction or contracting activities, is not in accord with proper ethical procedure.

Article 8 defines as unprofessional the "use of the advantages of a salaried position to compete unfairly with engineers in private practice."

This article is not intended to infer that salaried engineers such as professors for example, cannot ethically do outside consulting work. It is recognized that such work should better qualify the individual for the teaching profession and can be ethically done, provided the fees charged are equal to those charged by consultants in the same field and operating in the same area, and further provided that their consulting work is not prejudicial to their salaried position and has the approval of their employer. Within the limitations of the above provisions, other salaried employees may also ethically do outside work.

Article 9 is one of the articles regarding which questions most frequently arise. The following more definitive statements are therefore pertinent.

It shall be considered unprofessional:

a. to engage attorneys, men of influence, or outside professional contact men to aid in securing employment;

b. to make political contributions that may influence the selection of engineers on future work;

c. to solicit engineering work through other than members of the engineer's own organization;

d. to create obligation on prospective clients through extravagant entertainment, gifts, or similar expenditures;

e. to engage in "fee splitting" or other distribution of fees for other than services performed and in proportion to the value of such services; and

f. to solicit or accept an engineering engagement, or to submit a proposal of contract covering engineering services involving the economic feasibility of any project when the fee for such services is contingent upon the report being favorable to such project.

Article 10 is in effect an engineering affirmation of the Golden Rule which, if observed universally, would constitute sound ethical behavior. Some contingent fee contracts infringe on this article of the Code. See comments above under Article 9.

The engineering profession can take satisfaction in the fact that most of its relationships require no formal code of ethics to keep engineering conduct within the principles of ethical practice. Nevertheless the complexity of present-

day conditions and the broadening of professional fields make necessary adherence to a strict code of ethical principles such as discussed here.

Client-engineer relationships

Some who seek engineering services approach the matter as though engineering were a commodity which can be purchased on a competitive price basis.

The purpose of this statement is to acquaint prospective clients with procedures by which the public welfare may be best served in the selection of an engineer. Selection should be based primarily upon experience, judgment, professional ability and integrity. Selection upon the basis of these preeminent qualifications is the best assurance the client has against the possibility of engaging incompetent, inadequately experienced or unethical engineering services.

Engineering is a profession developed over the centuries to serve the needs of humanity. The practice of engineering necessarily involves a relationship of mutual confidence and interest between the client and the engineer. The esteem and stature which the engineering profession has achieved are not mere coincidence. They result from the efforts of countless men with searching minds, who have devoted themselves to the improvement of conditions affecting mankind. To enable the engineer to best serve humanity in the future, this background must be appreciated by both the client and the members of the engineering profession.

Engineering covers a wide range of endeavors affecting the public welfare. In modern times, engineers have become more and more specialized, with the result that the general connotation of engineer is sometimes erroneously accepted as a badge of proficiency in all phases of engineering. Both the clients and the engineers who serve them should, therefore, be fully aware of the requirements of the particular service desired from the engineers and the qualifications of those being considered for employment.

The client has the right to expect that the engineering services which he engages shall be competent, efficient and adequate for the full consideration of his problem. Many clients are unfamiliar with the services necessary for the proper solution of their specific problems and accordingly have little concept of the background of experience and qualifications essential for the proper solution.

Occasionally some public official expresses the view that public bodies must take bids for engineering services in the same manner that bids are taken for construction work. Fortunately, both for the public and the engineers who serve it, the fallacy of such views is becoming more and more recognized. There are scores of court decisions, going back a hundred years or more, which state that the taking of bids for professional services is neither mandatory nor in the public interest. As for example, one of the early decisions was that of People ex rel. Smith v. Flagg, 17 N.Y. 584 (1858), where the Court said: "It would be an unreasonable and mischievous construction of the statute to apply it to services which require in their proper performance scientific knowledge or professional skill." In the case of Cf. Stratton v. Allegheny County, 245 Pa. 519, 91 Atl. 894 (1914), the Court said that such statutory provisions are inapplicable "in the making of contracts for employment of attorneys, physicians, engineers, or others, involving professional skill."

Professional engineering services are the products of creative minds. Their quality depends upon intellectual ability, technical knowledge, judgment and experience. These attributes are not subject to any standard of measurement and no two engineers will render exactly the same service. It is fallacious to expect to obtain appropriate professional service on the basis of a low bid price submitted in competition. Cheap engineering creates an expensive product.

It is emphasized unequivocally that professional engineers cannot ethically engage in competitive bidding on a price basis to secure professional engagements. If bids from engineers are requested on that basis, the result will be that engineers best qualified to perform the desired services, will not make themselves available for employment.

Sound engineering assures the client of maximum value per dollar expended. The total project cost, including engineering, is a definite reflection of the qualifications, professional experience, judgment and integrity of the engineers performing the services. Any presumed saving in fee for one engineer or firm as compared with that for another less competent is almost certain to be exceeded many times over in additional costs of construction, operation and maintenance.

The best ethical procedure, and that designed to best serve the public, whose welfare is always paramount in engineering practice, results when the client chooses his engineer (or engineers) from among those who by reputation for integrity, experience, and other qualifications are best fitted to perform the services required. If he does not know which engineers have the particular qualifications needed, he should secure advice from others who have been confronted with similar problems. His selection should then be made from the individuals or firms particularly well fitted for the particular project by virtue of such things as past experience on similar projects, availability due to work load in their offices, location, etc. Possible ethical conflict of client interests may preclude consideration of those otherwise qualified. In most cases, since engineers of high ethical standing will undertake an engineering obligation at costs reasonable both to themselves and to the client, the fee can be definitely set after the engineer has been selected. An excellent check of the reasonableness of fees is available through the information contained in publications such as the ASCE Manual of Engineering Practice No. 38 and similar documents from other engineering societies relating to fees.

An engineer should not be asked to reduce his fees unless there is a commensurate change in the scope of the services involved. An engineer cannot ethically reduce his usual charges after being informed of charges named by another.

ASEE Issues Guide to Recruiting Engineers

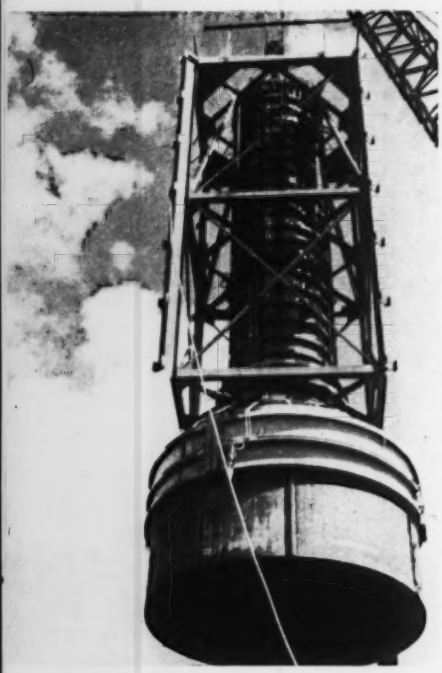
How to bring young engineering college graduates and would-be employers together to best advantage is the theme of a helpful guide to recruiting just released by the American Society for Engineering Education. The eight-page leaflet, entitled *Recruiting Practices and Procedures—1959*, is the second revision of an original guide first published in 1949. Called the ASEE "recruiting code," the guide now constitutes a supplement to the ECPD Canon of Ethics.

It is the hope of ASEE, according to Prof. W. Leighton Collins, secretary of the society, that the leaflet "gets into the hands of every engineering senior seeking employment, as well as recruiter and college placement officers. It is designed as an aid in the development and maintenance of high ethical standards in the procedures of college recruiting and in the relations between the employing organization, college authorities, and college students."

Copies of the guide may be purchased from ASEE at the University of Illinois, Urbana, Ill., at 10 cents a copy. For lots of 25 the price is $1.00, and for lots of 100 the price is $3.00.

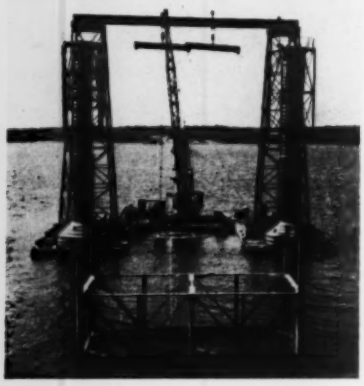
Exceptional job engineering

IRA E. WILLIAMS, Resident Engineer, Tulsa District, Corps of Engineers, Whitesboro, Tex.



The key to successful substructure work on the Willis Bridge over Lake Texoma is this watertight, self-stripping form.

Spud cage is set to position pile-driving template and later to take the high forms for underwater concrete placement in the dry.



A template for piles, a steel form that permits the placing of concrete in the dry in 60 ft of water, and an ingenious idea for placing loose-jointed continuous girders, added up to an economical and most interesting bridge job. The bridge carries highway route Okla. No. 99–Texas No. 10 over Lake Texoma on the Texas-Oklahoma line 75 miles north of Dallas. The work was done for the U.S. Army Corps of Engineers under a joint-venture contract in which Massman Construction Co. of Kansas City handled the substructure and John F. Beasley Construction Co. of Dallas placed the steel superstructure. The structure, which was designed by the Oklahoma Department of Highways, has four 90-ft I-beam spans and 26 continuous plate-girder spans, over piers 200 ft apart.

Piles are required for piers for lateral as well as vertical support. Conventional methods were used for the construction of the shore piers. Offshore, where the water depth varies up to 60 ft, the piers have separate footings for two round columns that are tied together just above the lake level and by a cap beam. Specifications required that concrete, except for a tremie seal over the piles under each column, be placed in the dry. It was in meeting this requirement that ingenuity, initiative and enterprise combined to develop an unusual type of foundation construction—but in a way that made the difficult seem routine.

Excavation at each pier site was accomplished by a crane and clamshell, the spoil being wasted by casting it away from the excavated area. The bottom of the excavation was then swept by an air-lift pump to remove any loose particles of excavated material remaining within the limits of the foundation.

Accurate alignment of offshore work was an important factor. In this case, alignment was controlled by accurately locating a structural-steel frame around the pier site. The frame was held in position by driving 10-in. pipe spuds through wells provided in each corner of the "spud cage." The spud cage served as falsework for locating and positioning the pile template and forms for the concrete to a point above the lake level. Space for adjustment within the cage was provided. After the underwater work was completed at a pier site, the individual spuds were pulled and tied to the frame and the cage was moved to another pier.

Either 12 or 13 piles were required under each column for piers in the water, except for a 15-pile group in one deep area. A pile template, 40 ft in length and weighing some 30 tons, contained a guide for each of the foundation piles. This template was set in one side of the spud cage and lowered to, or slightly above, the lake floor, where it was secured and accurately located in the frame. A 12-in., 74-lb bearing pile was inserted in the template and allowed to fall to the lake bottom where the template held it in position and plumb. A follower pile of the same cross-section, equipped with a driving head that insured constant close contact with the head of the pile being driven, followed the pile down. A 15,000-ft-lb hammer was used to drive the pile through overburden of sand, clay and gravel to refusal on shale. Information gained during the driving of each pile was used to forecast the probable length of the next pile in the pattern.

A tremie seal was planned to close the bottom of the caisson. This was "belled-out" to a larger size to accommodate the pile pattern. The shape of this part of the pier required that the piling extend not more than 2 ft 8 in. above its theoretical top elevation or that it be cut off to clear the form to be placed later for the concrete. This required care in forecasting pile lengths to avoid having to cut off piles under water. One pile template was used. It was moved to position for driving the adjacent footing and then to the next pier.

The next operation was to place the concrete seal and the portion of the pier that extends to the lake surface. The contract required that this concrete, exclusive of the seal, be placed in the dry, from a point 1 ft above pile cutoff grade to and above water level.

A special form for placing plastic

pays off on bridge construction

concrete under water was designed and developed by the contractor's engineering staff and has proved very effective. Watertight forms were built to the neat-line dimensions of the pier and were provided with neoprene gaskets at all joints to effect a positive seal. The forms were planned to confine the concrete from a point 1 ft below the top of the concrete seal to the bottom of the tie-beam, which is just a little above the lake surface.

Forms were hydraulically controlled and were designed to open, for the full height, at the one-third points around the periphery. Double-acting hydraulic cylinders opened or closed the forms, being controlled by valves located above the water. The steel forms were constructed by the Dixie Form Co. of San Antonio, from plans furnished by Massman. The section of the pier shaft that is above water is 5 ft in diameter. Below water to the top of the bell, the shaft is 6 ft in diameter unless this length exceeds 31 ft. Below the 31-ft depth, the shaft was made 7 ft in diameter to the top of the bell.

Two sizes of belled-out sections over the piles were used, 14 ft 8 in. in diameter and 16 ft 5 in. in diameter. Bottom sections of the form were supplied for each size. A circular steel form, dimensioned to the neat lines of the concrete seal, was placed on the bottom of the shaft forms before they were lowered into the water to confine the seal concrete. This part of the form remained in place and was known on the job as "the permanent ring." This complete form was lowered over the nest of piles. Minor lateral adjustments in alignment were made by actuating double-acting hydraulic cylinders, which moved the form laterally within the spud cage.

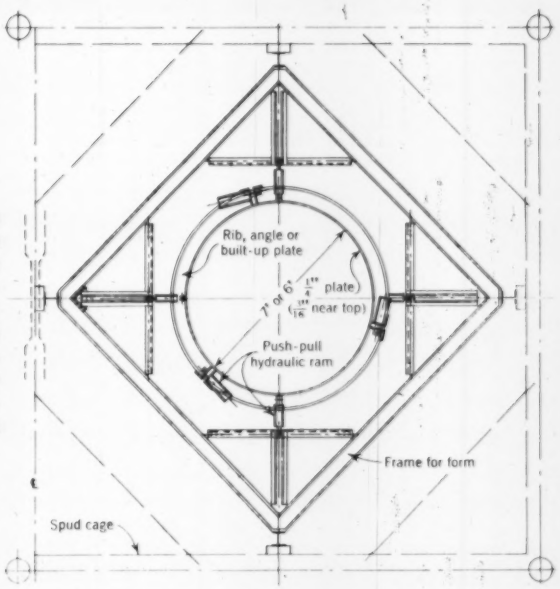


FIG. 1. Hydraulic push-pull rams are set to position a form exactly, far below the water surface. The three ram units on the periphery hold the form watertight for concreting, then open it for stripping.

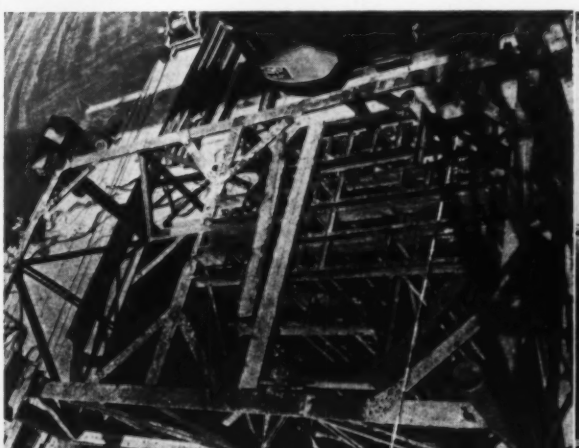
A 5-ft tremie seal was placed by the common constantly-filled pipe method. Concrete was mixed on shore and taken to the pier by barge. The seal effectively closed the bottom of the form. As soon as the concrete had set sufficiently, usually within 72 hours, the forms were dewatered. This was a much smaller job than dewatering a cofferdam as only the space to be filled by concrete was pumped out. Laitance was removed from the top of the seal, piling was cut off to the desired level, reinforcing steel was set, and the concrete placed in the dry to a construction joint above the water surface.

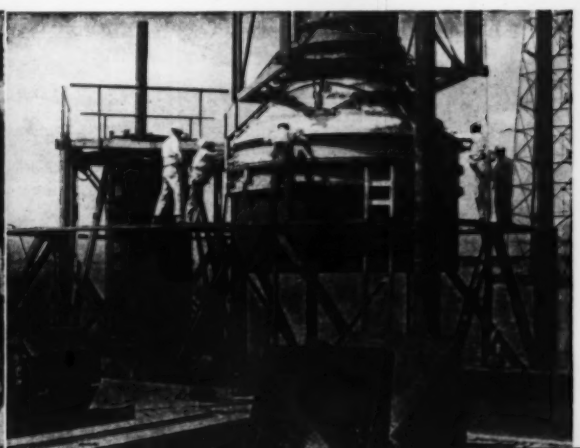
After this concrete had been in place 48 hours, the hydraulic cylinders were actuated to open the form, which was thus stripped from the concrete and released from the permanent ring around the tremie seal. The form was then lifted vertically and placed on a barge for transfer to the next location.

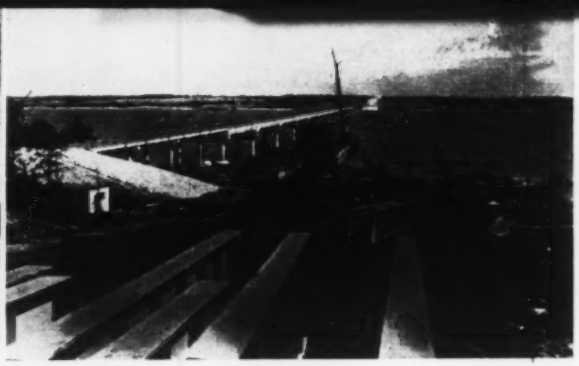
The parts of the concrete columns above water were completed by more conventional methods, utilizing steel forms supplied by the Blaw-Knox Co. The forms, except for the permanent ring, were used repetitively.

It will be seen that, by competent

Left: Top of pile template is positioned inside the spud cage. Right: Forms for underwater concrete, with "permanent ring" for enclosing the tremie seal, are being set in spud cage. Note flotation belts and hard hats worn by all workmen.







Left: Steel forms were used also on above-water sections of piers. Right: Looking from assembly yard toward lake, a side-boom tractor is carrying girder to crane for assembly on floating falsework. Note four 90-ft beam spans in left foreground.

job engineering and careful scheduling, a complicated procedure became a routine assembly-line performance. The contractor was able to spread his work out to the extent that a complete pier was placed in 8 calendar days. Job forces were enthusiastic about the underwater forms built to the neat lines of the pier. It is felt that this method will frequently replace caissons or temporary cofferdams for such work.

Superstructure erection

Continuous plate-girder spans made up the principal steel for the crossing. Each 200-ft span consists of a haunched girder section 11 ft 3 in. deep, extending 35 ft on each side of the pier, and a 130-ft-long, 7-ft 10-in.-deep section. (End spans are 165 ft.) Four such girders spaced 9 ft 4 in. on centers, carry the cast-in-place concrete deck, 28 ft wide and 7 in. thick, with sidewalks 3 ft wide cantilevered on each side.

To erect the steel without falsework from the deck was impossible because of the hinged expansion devices at many locations, and the span length. Erection over floating falsework was a possibility but would have required a large fleet and more hoisting equipment than was available on an inland lake. Conventional falsework supports would have been time-consuming and expensive to install.

To meet this erection problem, the John F. Beasley Construction Co. erected steel falsework built up on barges. Individual spans were floated out to position in length of 130, 200 or 270 ft after assembly from a temporary pier constructed along the shore. Since steel for the bridge weighs about one ton per foot of length, a unit for placement might weigh as much as 270 tons.

Girders were stored, and the 130-ft units spliced where necessary by field welding, at a yard on shore. Individual girders were transported from the yard to the waterfront by a side-boom tractor. A big crane set the girders on a floating unit made up of 45 barge sections, each 10 x 20 ft and 8 ft deep. (The barge sections were built this size so that they could be easily transported overland when required.) Heavily framed falsework, set at 91 ft 6 in. on centers on the barges, was equipped with hydraulic jacks of 300-ton capacity for vertical movement.

A girder 130 ft long and 7 ft 10 in. deep was first set on the falsework and guyed for temporary stability. The other three girders were set in place and the cross bracing installed to complete all the steel erection on the unit.

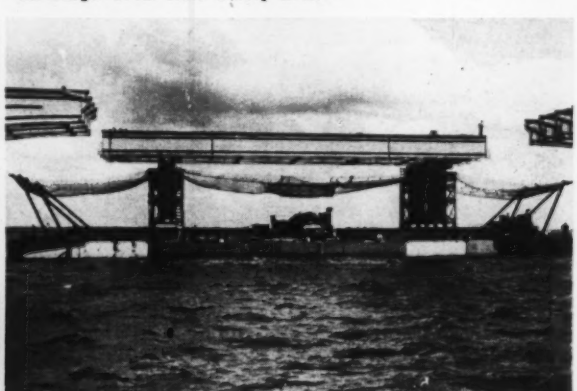
For placing in the bridge, the 130-ft section might have one or two haunch sections assembled with it. Haunch sections and their cross bracing were added as an overhang by making bolted aerial connections. When the assembly was completed, it was floated out to position in the bridge and lowered on to the supporting shoes, where it was tack welded pending the final alignment of the structure. Sections with pinned expansion ends were connected in final position.

Work on the substructure was planned and supervised by Tom Kinter, Chief Engineer, and E. J. Wildermuth, Project Manager, of Massman Construction Co. Steel erection was handled by J. R. Patterson, General Superintendent, and Paul W. Brothers, Project Manager, for John F. Beasley Construction Co. Deck concreting is being done by J. A. Raines of Muskogee, Okla., with C. McFarland as Project Superintendent. Col. Howard W. Penney is District Engineer, Tulsa, U. S. Corps of Engineers, succeeding Col. John D. Bristor, who retired in August 1959.

Completion to a usable condition is expected by late spring, well ahead of a November contract completion date.

Construction of the Willis Bridge illustrates how, by expert application of job engineered techniques, two companies are keeping pace with rising costs. There is a dollars-and-cents meaning to this as the methods described permitted completion of the substructure and erection of structural steel five months ahead of the original construction schedule. Such savings can only be realized by constantly developing procedures and techniques that utilize new materials and equipment.

Left: Each of the four falsework towers has a 300-ton jack built into it for lowering the assembled span onto the piers. Right: Center 130-ft section, with pinned ends, is positioned by hoists on barge deck. Note safety nets.



GEOMETRIC DESIGN of modern highways

C. H. LANG, F. ASCE, Chief Engineer, New York State Thruway Authority, Elsmere, N. Y.

In urban areas an expressway must often be designed with only a narrow curbed median. Shown is the full clover-leaf interchange between the Thruway and the Cross County Parkway in Yonkers, with intermediate service roads.

So much has been said, and is still being said these days, about the design and construction of modern highways, that it is rather difficult if not impossible to express an opinion that is wholly new. I shall therefore confine this article to a description of three aspects of expressway geometry which I deem of major importance, and trust that if these ideas are not new to the reader, their repetition will at least serve to confirm their importance.

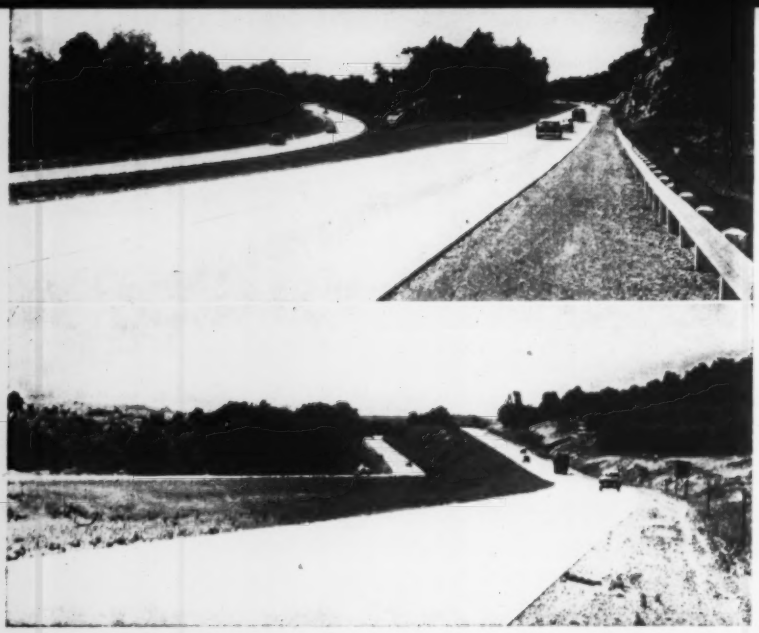
At this point, the reader might well ask, "What about the geometric design of ordinary highways? Why confine your opinions solely to expressways? Doesn't the ordinary two-lane road without restricted access still constitute the major portion of highway mileage that exists in the country today?" The answer to the latter question is of course, "Yes," and the importance of these roads to the economy must not be forgotten in the enthusiasm and excitement of implementing the Federal Aid Highway Act of 1956. Actually, I am sure that they are not being neglected, as the average state highway department continues to reconstruct many miles of existing highways each year.

The fact, though, that these highways, in general, are "reconstructed" rather than "constructed" is the reason why modern concepts of design are not always practicable when plans for the improvement are under way. Most of our roads follow long established contours of travel. They are lined with farms, homes and business establishments which have developed over the years. Except for an occasional flattening of a curve, the reduction of a grade or a small amount of pavement widening, there is no opportunity for the highway engineer to apply his knowledge of modern highway designs to a whole, integrated road except at prohibitive cost and amid the screams of outraged citizens who consider themselves adversely affected in some way by the new facility. The same is not usually true of the modern interurban expressway, so, rather than discuss the desirable geometry for a type of road which at present can, in most cases, be constructed only in theory, I will confine myself to a description of just a few aspects of expressway design that I consider most important.

The first of these is the matter of separating opposing roadways. All modern expressway designers recognize the desirability of such separation, but differ sometimes materially in the details by which it is accomplished. We encounter therefore trunk highways where the separator varies from a barrier type a few inches in height and width, to others with medians so wide that opposing roadways cannot be seen one from the other. Each of these extremes in design, as well as each of the intermediate types, has its place and no doubt can be justified for reasons of economy, availability of right-of-way or for some other reason. It is obvious however, even to the casual user, that some designs are far superior to others in their functioning.

Certainly it is my opinion that in open country, where right-of-way is no problem, the varied-width mall or median is the ideal design. It allows each roadway to be planned as an individual unit and to be fitted to the terrain in both plan and profile in such a manner as to effect the maximum economies. If done properly, the finished construction is scenic, pleasing to the average driver, and above all, safe. It is safe for the reason that the widely separated roadways preclude or at least minimize head-on collisions. In addition, particularly if separate profiles are also established, headlight glare is eliminated or reduced thus establishing a further element of safety. A good example of this type of design is shown in one of the accompanying photographs.

For many reasons it may not be ex-



A median of variable width, as seen, top, on the New York State Thruway near Catskill, offers maximum safety. In addition, each roadway can be planned as an individual unit and fitted to the terrain in such a way as to effect maximum economies. Scene directly above, on the Thruway near Newburgh, N. Y., shows opposing roadways, each with its own plan and profile.

pedient to always provide a mall or median of varied width. Under such circumstances the next most satisfactory design is one which provides a center divider wide enough to keep traffic in one direction an far as possible from traffic in the other direction. Another photograph illustrates a uniform-width mall of over 100 ft in the middle western part of the Thruway System.

Unfortunately, because of the high cost of real estate in urban areas, expressways in cities must be designed with narrower separators. A portion of the New York State Thruway in Yonkers, also shown in an accompanying photograph, is of this type. Here a curbed median 12 ft in width is used and to date has a good service record. However the problem of headlight glare is present. Should experience so dictate, it is possible to construct, within the 12 ft, a positive barrier which will prevent both headlight glare and head-on collisions. The design allows positive measures in this respect to be taken should they be indicated.

This photograph also serves to indicate several other geometrical features necessary in the construction of expressways, some of which will not be elaborated on in this article. In the foreground is seen a full clover-leaf interchange between the Cross County Parkway in Westchester County and the service roads which flank the main Thruway in this area. Transfer of traffic between the Parkway and the Thruway is accomplished by means of slip ramps between the Thruway and the service roads. Many other slip ramps are furnished in order to fully accommodate the heavy entering and leaving traffic in this busy community.

Since it is not always possible to provide a median of varying width, many of today's highways have uniformly wide malls as on the New York Thruway near Rochester. The 100-ft divider effectively separates traffic, thus preventing many accidents.

The second factor of importance in expressway geometry is the matter of the relationship of the geometry in plan to the geometry in profile. Almost everyone who uses a modern turnpike is aware of the flat grades and long-radius curves which are employed to give long sight distances and thus permit the 60 to 70-mph speeds allowed on these roads. In general, no problem exists therefore between interchanges. It is at the interchanges that trouble sometimes develops if the utmost care is not taken in correlating plan and profile.

For example, let us assume that the topography in the vicinity of a proposed interchange is such that an exit ramp must be constructed in an area where the expressway curves to the left, and at the same time approaches the summit of a vertical curve. Unless great care is taken to locate the bifurcation point between the expressway and the ramp well off the vertical curve, in other words, on the ascending or descending grade, it is quite possible that the finished construction will lead motorists who desire to continue on the expressway into the exit ramp. The results can be quite dangerous when a motorist realizes the error.

The ideal location for an interchange is on a tangent near the sag of a vertical curve connecting two long descending grades. Here, all the ramps are visible from both directions and the motorist gets a clear picture of the layout. The next most desirable location is on a tangent or a curve of very long radius where the gradient is uniform. The least desirable is the summit condition outlined above.

Unfortunately, nature and man do not always cooperate in fixing the topography so that interchanges can be built at the most advantageous sites. On the Thruway the trumpet-type interchanges, which are particularly satisfactory for toll roads, require a minimum distance of about 3,000 ft along the axis of the expressway from the beginning of the exit ramp to the end of the entrance ramp. In many cases the required distance is even greater, so that it is often difficult to get conditions which will make for ideal geometry of the finished highway. There is no adequate substitute however for careful planning, and a properly designed and constructed facility will pay dividends in a smaller accident rate and a better functioning of the interchange with a minimum of signing and pavement striping.

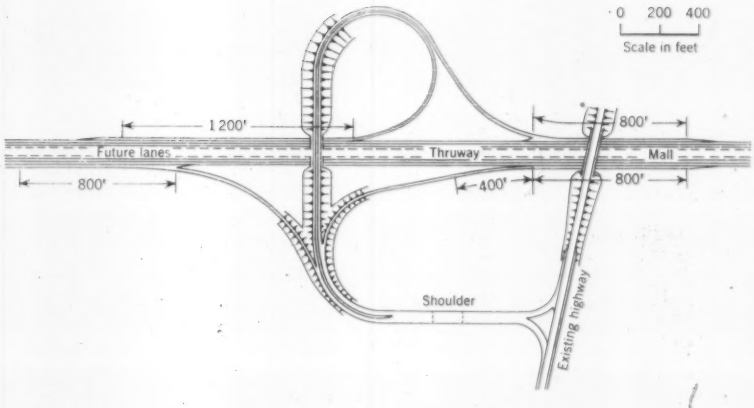


FIG. 1. A trumpet type of interchange, as used on the New York State Thruway, has proved both economical and functional for toll highways.

In this connection it is well to consider also the fact that in addition to regular interchanges, the modern expressway will eventually have to provide rest areas, service areas and perhaps other facilities for the use of the public which will make it necessary for the motorist to leave and reenter the expressway. In designing rest areas for the Thruway it was determined as a matter of policy, that such rest areas would be furnished with the same lengths of exit and entrance ramps as were the interchanges and service areas. This determination was made for the obvious reason that a decelerating or accelerating vehicle at a rest area creates the same traffic problem as the same vehicle at any other exit or entrance to the main line of the Thruway.

It was surprising to us how difficult it was to select rest-area sites which met the criteria for alignment and grade outlined in the preceding paragraphs. All the suitable locations seemed to be situated in areas between bridges which had not been designed to provide for the additional clearance required for the construction of new speed-change lanes. In some cases the problem will only be solved by adding to or rearranging some of the drainage or other structures.

The third matter of concern in the design of a modern trunk highway is the geometry of its interchanges. For toll highways such as the New York State Thruway, the New Jersey Turnpike, the Pennsylvania Turnpike and others, which employ the interchange type of control as opposed to the barrier type of control such as is used on the Garden State Parkway, the trumpet interchange is most satisfactory. It is economical in that it requires a minimum of expensive bridges and only one set of toll booths, and is functional in that it can easily be designed to slow traffic to a pace which minimizes the danger of collisions at the toll booths. Figure 1 shows a typical Thruway interchange.

Note the lengths of accelerating lanes as compared to the lengths of decelerating lanes. The former are made almost 50 percent longer to enable heavier vehicles to attain greater speeds at the points of entry with the main traffic stream. Note also the gradual change of radii of the ramps, in order to attempt to match the radius of curvature with the probable speed of the vehicle. It will also be observed that speed-change lanes are provided not only adjacent to the Thruway, but also adjacent to the regular pavement on the existing highway. The pavement of the latter is also widened so that through traffic on the highway will not be hindered by entering or exiting traffic to or from the Thruway.

Toll highways generally provide for entrances and exits only at cross roads of major importance. For similar roads which cross the toll-free portions of the National System of Interstate and Defense Highways, interchanges of the full clover-leaf type will, in all probability, replace one Thruway trumpet type, and the diamond type will probably replace another type. In addition, other types of exits and entrances must be provided at roads of lesser importance.

The full clover-leaf interchange provides all the basic elements necessary for the safe and effective movements of traffic. It must of course be designed with speed-change lanes adequate for both the superhighway and the road with which it connects. The diamond-type interchange however, unlike the full clover-leaf, permits cross traffic on the existing highway. So does one type of Thruway interchange. It seems obvious therefore that for safety and ease of operations, the existing highway should be widened and provided with accelerating and decelerating lanes in order to minimize interference with traffic on the existing road. I regret that some designs have advanced to construction without this desirable feature.

It is impossible in the space here permitted to explore specifically all the problems pertaining to interchange design that will arise in the course of completing the Interstate System. The one paramount consideration in each design should be safety in its operation. Every point at which traffic can enter or leave the expressway is a potential hazard, whether it be an interchange, a service area, a rest area or some other facility. Sameness of design which leads to driver boredom and ultimate hypnosis or sleep is another hazard. Full consideration and recognition of the importance of good geometrical design will go a long way toward reducing these inherent hazards to highway travel.

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

City	Current	Previous
Atlanta	1.13	1.13
Baltimore	1.14	1.12
Boston	1.22	1.18
Chicago	1.43	1.36
Denver	1.21	1.21
Houston	1.26	1.26
Kansas City	1.16	1.11
Los Angeles	1.23	1.21
Miami	1.57	1.57
New Orleans	1.18	1.03
New York	1.28	1.25
Pittsburgh	1.04	0.95
Portland (Ore.)	1.25	1.16
San Francisco	1.24	1.24
Seattle	1.06	1.06

Highway Departments

Region	Current	Previous
I, New England	0.90	0.92
II, Mid Atlantic	1.14	1.13
III, Mid West	1.22	1.16
IV, South	1.14	1.08
V, West	1.03	1.02
VI, Far West	1.13	1.11

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current salary total for ASCE Grades I, II and III by an arbitrary base. The base used is $15,930. This is the total of salaries paid in 1956 for the equivalent Federal Grades GS5, GS7 and GS9. Only the annual base entrance salaries are used in these calculations. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was July 31, 1959.

(Continued from page 43)

Executive Committee Meets in Nashville

The Executive Committee of ASCE met at Nashville, December 4, to conduct interim business of the Society. This committee is composed of President Marston; two immediate Past Presidents, Howson and Friel; and the four Vice-Presidents—Elsener, Holland, Knapp and Molineaux—with Secretary Wisely.

The Committee approved and authorized publication of a "policy statement on the best use and relationship of private consulting services and permanent engineering bureaus in Federal agencies . . . for appropriate presentation to any Congressional body that may consider this matter." The statement appears on page 68 of this issue.

Joint Engineering Management Conference

ASCE has been a "cooperating society," without financial responsibility, in the Annual Engineering Management Conferences which are currently sponsored by ASME and AIEE, with other societies cooperating. ASCE is now invited to become a full sponsor. While this would actually involve assumption of some financial liability if any conference did not prove to be self-supporting, it should be noted that there is at this time a surplus of $3,500 that has accrued from previous conferences.

It was voted to authorize participation by ASCE in the Joint Engineering Management Conference to be held in Chicago in September 1960 as a sponsor, with financial liability not to exceed $500. This will result in even more active participation by ASCE than in the successful meeting held in Los Angeles last September.

Professional Practice of Soils Engineering

A group of consultants in the field of soils engineering has requested authorization to form an ASCE Committee on Professional Practice of Soils Engineering to function either within the Soils Mechanics and Foundations Division or as a Subcommittee of the Committee on Professional Practice. The purpose of the committee would be to resolve problems presently confronting engineers in the private practice of soils engineering, particularly in the delineation of professional and non-professional services. The question was raised by the Texas Section and discussed informally by a larger group during the Washington Convention.

It was voted by the Executive Committee to refer the proposal to the Committee on Professional Practice, with a recommendation that a Task Subcommittee on Professional Practice of Soils Engineering be created for one year to resolve existing problems in the delineation of professional and subprofessional services, and determine means to bring about professional recognition for soils engineering services in general. The subcommittee will develop recommendations for review by the Committee on Professional Practice prior to submittal to the Board of Direction.

New Headquarters for Engineers' Club of St. Louis

Dedication of a new headquarters building for the Engineers' Club of St. Louis took place on November 5 in ceremonies attended by over 1,000. In the featured talk Dr. Alexander S. Langsdorf, dean emeritus of the School of Architecture and Engineering at Washington University, called the present educational system in the U.S. too soft and advocated a twelve-month year "to bring students more nearly up to their potential achievement."

The beautiful modern building, located at 4359 Lindell Boulevard, replaces a structure at the same address which had been club headquarters since 1920. Designed around an arrangement of equilateral triangles, it has a 400-seat auditorium, a library, and administrative offices. The building, with its furnishings, represents a $400,000 investment, for which funds have been raised over a twenty-year period. Construction was started in July 1958.

The structure was designed by the architectural firm of Russell, Mullgardt, Schwarz and Van Hoefen, with Eason, Thompson & Associates as the consulting structural engineers and Ferris & Hamig as the consulting mechanical engineers. The Gamble Construction Company of St. Louis was the contractor.

According to President Clarence H. Ax, F.ASCE, the St. Louis Engineers' Club is the third oldest engineering society in the United States. Organized in 1868, it is antedated only by ASCE and the Boston Society of Civil Engineers.

New $400,000 headquarters building for the Engineers' Club of St. Louis is of brick with a panel of slate. It has concrete floors, with terrazzo finish, and cantilever concrete slabs over the front windows to act as shades. Construction features a triangular motif.

Board Approves Formation Of Three New Branches

Formation of a Waco Branch in the Texas Section was authorized by the Board of Direction at its Washington, D. C., meeting. This brings to fourteen the number of Branches needed to serve the far-flung Texas Section area. Formation of two new Branches in the South Dakota Section—a Black Hills Branch and an Eastern Branch—was also authorized.

With addition of these new units, ASCE now has 78 Local Sections, 65 Branches, seven Younger Member Forums, and eleven Wives Groups.

Consultants and Government Work

At its Washington, D. C., meeting the Board of Direction took action requesting, "that the Secretary prepare a suitable policy statement on the best use and relationship of private consulting services and permanent engineering bureaus in Federal agencies, to be cleared by the Executive Committee for appropriate presentation to any Congressional bodies that may consider the matter." The proposed policy statement was adopted by the Executive Committee at a meeting in Nashville, Tenn., early in December, and is given here.

The American Society of Civil Engineers is concerned with the implications of Report 424, prepared by the Appropriations Committee of Congress, requesting full-scale investigations of governmental agencies using consulting engineering and architectural firms. While this action is directed at Federal agencies, its impact could be felt in all public agencies at federal, state, and local levels unless a concerted effort is made to present the underlying facts regarding supplementary use of private consulting services in the performance of public engineering work.

The Society's 44,000 members include more than 13,000 professional engineers in the service of all levels of government, and at least 9,500 engineers engaged as principals or employees in the private practice of engineering. With primary regard for the public welfare, and in the professional interest of these segments of membership, it is incumbent upon the Society to recommend a policy that will insure the most efficient and economical use of all engineering services. To this end the following statement is offered.

The Society acknowledges the advantages inherent in the establishment of engineering departments in public agencies provided that: (1) the permanent staffs of such agencies are of such size and competency as to handle engineering functions that are relatively uniform in character and volume; (2) regular appropriations are adequate for maintaining salaries and conditions of employment at appropriate professional levels; and (3) supervisory engineering personnel are represented at the management and policy-making levels of such agencies.

The Society, however, considers it unrealistic, economically infeasible, and at variance with good profsesional practice for public agencies to expand their engineering organizations during periods of peak demand, to retain key personnel beyond normally justifiable needs, and summarily to release large numbers of competent personnel during slacks periods of operation. High overhead costs result from such practices and are difficult, if not impossible, to allocate in the determination of the true overall costs to specific projects.

The alternative to such cut-backs in slack periods is unjustifiable expenditure of public funds for the maintenance of over-sized staffs. The permanent engineering organization in a public agency should be fitted to that character and volume of work which represent a minimum constant load.

When exceptional conditions arise which require expansion of staff to accomplish an assignment not practical of delegation to private engineers, then:

1. Short-term employment should be on a strictly temporary basis, without extension of civil service or tenure privileges normally available to permanent staff and
2. Long-term programs should be staffed with a view to gradual absorption of temporary personnel as replacements for permanent staff, to the end that there is no increase in permanent staff required for the minimum constant load.

When the permanent engineering organization of a public agency is not capable of handling the increased work load, private firms should be employed for:

1. Unusual projects demanding special training and experience
2. Emergency programs
3. Projects of magnitude beyond the capacity of a public engineering bureau

Private firms are not restricted by seniority and Civil Service rules in hiring personnel with special skills and experience. Thus, they are better able to adjust their work forces to meet varying demands and to allocate such costs to specific projects.

Charges that private firms may overdesign to boost construction costs in the interest of collecting higher engineering fees are contrary to the principles of ethical practice of professional engineering. If such charges are substantiated with regard to any ASCE member involved, they should be brought before the Society. If they are found in violation of the Society Code of Ethics, disciplinary measures would be taken in accordance with established rules and procedures.

Instances of unethical practice only serve to emphasize the importance of negotiating engineering agreements solely with firms of recognized high standing. They also serve to emphasize the fallacy of inviting quotations competitively and awarding contracts on the basis of price as the prime consideration.

Any official who is qualified for high office of public trust is capable of negotiating equitable fees for engineering services. He knows from experience, and within close limits, the reasonable levels of fees for the services his agency requires. Fee schedules have been published by fully competent organizations. ASCE Manual 38, *Private Practice of Civil Engineering*, is a prime example. The fee schedules presented therein are not arbitrarily set. They are representative of current rates in all parts of the country and are presented as a guide for establishing fees on a basis that has proved equitable to both engineer and client.

Percentage of construction cost has proved to be a practical means of determining a fee. However, it is not the only basis that may be used. ASCE Manual 38 presents other types of agreement, including: (1) Fixed lump-sum fee; (2) cost plus a fixed fee; (3) salary costs times a factor plus incurred expenses; (4) personal services on a per diem or hourly basis; (5) cost-plus basis when scope of work is difficult to determine; (6) retainer fee; and (7) retainer plus per diem rates.

Conclusion

There is a proper and desirable place for both public engineering bureaus and for engineers in private practice in the performance of engineering functions in governmental agencies. It is only the degree to which either type of service can most efficiently be employed that is subject to determination in a specific instance. Such decisions are best left to the judgment of competent and experienced engineering administrators. It is believed inappropriate to attempt to establish rigid rules by legislation or similar regulation.

Illinois Sections TV Series—A Great Success

The Illinois Section's recently completed TV series devoted to "Careers in Civil Engineering" has been an unqualified success in arousing interest in the profession and getting it publicity. The last of the weekly programs was presented on November 12. Since then the Section has received some 500 letters. Says the Section, "Some of the writers thought the TV series should be continued. Others wanted to know more about ASCE. None of the letters contained adverse comment."

The most rewarding result of the program was a letter from the head of the civil engineering department at Illinois Institute of Technology, saying that there was a marked increase in engineering enrollment at I.I.T. this year, which he attributed "at least partially to the TV series."

Donald Walsh, chairman of the Section's Program Committee and a moving spirit in arranging the series, writes "The purpose of the five programs was to acquaint the high school and college students of the Chicago area with the requirements and rewards of a career in civil engineering, and also to familiarize the general public with the various fields of civil engineering activity. The need for such an educational program was based upon the drop in enrollment experienced by the engineering schools in this country during the past two years. The officers of the Section felt that it was as much a duty of the Society as of the schools to educate the public as to just what civil engineering is."

The concluding program appropriately dealt with ethics and registration—the indispensables to an understanding of professional stature. The TV listeners were told by a panel of Section members about licenses, fees, engineering education, unions, and opportunities for young engineers.

The Section's special thanks are going to Mr. Walsh "who made all the arrangements and did most of the work necessary to make the series a success." Mr. Walsh moderated the programs.

ASCE Membership as of December 9, 1959

Fellows	10,886
Members	15,658
Associate Members	17,752
Affiliates	92
Honorary Members	47
Total	44,435
(December 9, 1958	42,529)

New Soil Mechanics Award Will Honor Karl Terzaghi

The Soil Mechanics and Foundations Division is heading a move to establish an award to honor Prof. Karl Terzaghi, Honorary Member of the Society, three-time winner of the Norman Medal and the father of soil mechanics. It is expected that the award will become one of the premier awards of the Society. It will be made for outstanding contributions to soil mechanics and foundation engineering published in any of the Society's publications. The award will be given at intervals of one to three years and will be accompanied by an appropriate honorarium. Recipients need not be U.S. citizens or members of the Society.

A Terzaghi Award Committee has been formed to invite contributions from individual engineers and from engineering and contracting firms towards a sum to establish the award in perpetuity. The Committee invites all interested engineers and firms to participate in this most worthwhile effort, which will have the dual purpose of recognizing outstanding contributions to engineering knowledge and at the same time Dr. Terzaghi's exceptional contributions to the profession.

Checks should be made out to Harold T. Larsen, F. ASCE, Treasurer of the Award Committee, and sent to Stanley J. Johnson, Chairman, at 415 Madison Avenue (10th Floor), New York 17, N.Y., or to any member of the Terzaghi Award Committee. The names of all committee members will be sent upon request to Mr. Johnson or to any other member of the Executive Committee of the Soil Mechanics and Foundations Division. All contributions are tax deductible, and each will be acknowledged. The Division hopes that many members of the Society will express their appreciation of Dr. Terzaghi's contributions by helping to establish the award. Additional information about the award will be supplied by Mr. Johnson.

Past President Howson Is Chicago Engineer of Year

ASCE Past President Louis R. Howson was named Chicago Civil Engineer of the Year at a meeting of the Illinois Section held at the Chicago Engineers Club on December 9. In the first action of the kind in its 43-year history, the Section presented Mr. Howson a plaque honoring him for "Excellence in our profession, leadership in our Society, and his humanity."

The award was established in recognition of the fact that Chicago civil engineers are taking an increasingly prominent part in the development of the Chicago area "as a better place in which to live, learn, work and play." It will be presented annually to the outstanding civil engineer in the Chicago area. Says the Section, "The award, in addition to recognizing and rewarding individual professional excellence, will publicize the activities of the Illinois Section and help to attract better qualified students of our ranks by increasing the public's awareness of the profession."

Mr. Howson, who was President of ASCE in 1958, is senior partner in the Chicago consulting firm of Alvord Burdick and Howson. In his 51 years as a consultant, he has been retained on water supply and sewage problems by many large U. S. cities.

Robert L. Kennedy, president of Illinois Section, presents Mr. Howson with plaque honoring him as Chicago Civil Engineer of the Year for 1959. In background is John G. Hendrickson, Jr., president-elect of the Illinois Section for 1960.

New ASCE Committee Personnel

Fewer than 2,000 members—or roughly less than two members out of every forty—do the work of the Society by manning its committees, professional and technical. To these relatively few members the rest of the membership is deeply indebted for contributing of their time and talents to making ASCE the efficient and influential organization it is.

Committee personnel for 1960 were confirmed by the Board of Direction at its meetings in Washington this October. The committees of the Board follow (all terms expire in October 1960 unless otherwise noted).

Executive Committee: Frank A. Marston, *chairman;* Lloyd D. Knapp, *vice-chairman;* Paul L. Holland, Lawrence A. Elsener, Charles B. Molineaux, Francis S. Friel, and Louis R. Howson.

Society Honors: Frank A. Marston, *chairman;* Lloyd D. Knapp, *vice-chairman;* Paul L. Holland, Lawrence A. Elsener, Charles B. Molineaux, Francis S. Friel, and Louis R. Howson.

Districts and Zones: Lloyd D. Knapp, *chairman;* Paul L. Holland, *vice-chairman;* Lawrence A. Elsener and Charles B. Molineaux.

Professional Conduct: Craig P. Hazelet, *chairman;* N. T. Veatch, *vice-chairman;* Wayne G. O'Harra, Earl F. O'Brien, Thomas M. Niles, and Bernhard Dornblatt.

Publications: Philip C. Rutledge, *chairman;* Thomas M. Niles, *vice-chairman;* Tilton E. Shelburne, Weston S. Evans, Sr, Wayne G. O'Harra, and Bernhard Dornblatt.

Membership Qualifications: Don H. Mattern, *chairman;* Earl F. O'Brien, *vice-chairman;* Philip C. Rutledge, Weston S. Evans, Sr, Thomas M. Niles, and Bernhard Dornblatt.

Division Activities: Lloyd D. Knapp, *chairman;* Charles B. Molineaux, *vice-chairman;* John E. Rinne, Daniel B. Ventres, Thomas J. Fratar, Charles W. Britzius, Elmer K. Timby, Samuel S. Baxter, Woodrow W. Baker, and Philip C. Rutledge.

The Auxiliary Administrative Committees will be:

Budget: Charles B. Molineaux, *chairman;* E. Leland Durkee and Clinton D. Hanover, Jr.

Securities: George W. Burpee, *chairman;* David G. Baillie, Jr., and Elmer K. Timby.

Convention Policy and Practices: Daniel V. Terrell, *chairman* (1962); Glenn W. Holcomb (1960), William J. Hedley (1961), Arthur J. Fox (1963), and Don H. Mattern (1964).

Society Fellowships, Scholarships, Grants and Bequests: Lorenz G. Straub, *chairman* (1960); Martin A. Mason (1961), George H. Hickox (1962), Samuel B. Morris (1963) and E. P. Fortson, Jr. (1964).

Application Classification: Albert Haertlein, *chairman* (1962); William J. Shea, *vice-chairman* (1960); Harold L. Blakeslee (1961), and Philip C. Rutledge, *Cont. Mem.* (1960). *Alternates:* Van Tuyl Boughton, Oliver W. Hartwell, and Howard T. Critchlow (all 1960).

The new Professional Committees are:

Conditions of Practice—Executive Committee: Paul L. Holland, *chairman;* Lawrence A. Elsener, *vice-chairman;* and five contact members from the Professional Committees—Trent R. Dames, Don H. Mattern, Fred H. Rhodes, Jr., N. T. Veatch, and Craig P. Hazelet.

Younger Members: John E. Heinzerling, *chairman* (1961); Glenn L. Enke, *vice-chairman* (1962); Nomer Gray (1960), Elwood R. Leeson (1963), and Trent R. Dames, *Cont. Mem.* (1960).

Local Sections: John R. Campbell, *chairman* (1961); Nathan D. Whitman, Jr., *vice-chairman* (1962); Frank C. Mirgain (1960), Ernest M. Titus (1963) and Trent R. Dames, *Cont. Mem.* (1960).

Student Chapters: Ray K. Chalfant, Jr., *chairman* (1961); Thomas E. Stelson, *vice-chairman* (1962); Lauress L. Wise (1960), Joseph S. Ward (1963), Eldred B. Murer (1964), and Fred H. Rhodes, Jr., *Cont. Mem.* (1960).

Engineering Education: Alfred R. Golze, *chairman* (1961); Clarence H. Ax, *vice-chairman* (1962); Jack E. McKee (1960), Armour T. Granger (1962), Thomas B. Sear (1960), N. A. Christensen (1961), George Langsner (1963), Kenneth B. Woods (1963), and Fred H. Rhodes, Jr., *Cont. Mem.* (1960).

Registration of Engineers: George W. Bradshaw, *chairman* (1961); Ellis E. Paul, *vice-chairman* (1962); John C. Park (1960), James M. Gongwer (1963), and N. T. Veatch, *Cont. Mem.* (1960).

Engineers in Public Practice: Frank L. Weaver, *chairman* (1961); Simon W. Freese, *vice-chairman* (1962); Mercel J. Shelton (1960), Don M. Corbett (1960), Blucher A. Poole (1961), Charles H. Capen (1962), Carey H. Brown (1963), John F. Tribble (1963), and N. T. Veatch, *Cont. Mem.* (1960).

Professional Practice: John W. Frazier, *chairman* (1962); Edmund Friedman, *vice-chairman* (1962); James A. Cotton (1960), William W. Moore (1960), Roger H. Gilman (1961), Charles M. Wellons (1963), Charles W. Yoder (1963), James L. Konski (1961), and Craig P. Hazelet (1960).

Employment Conditions: Irving F. Ashworth, *chairman* (1961); Jack Y. Long, *vice-chairman* (1962); R. Earl Salveter (1960), James A. Higgs (1963), Oscar S. Bray (1963), William J. Carroll, Jr. (1961), and Don H. Mattern, *Cont. Mem.* (1960).

Appointments to the Technical Committees are as follows:

Research: Harold B. Gotaas, *chairman* (1961); Ralph E. Fadum, *vice-chairman* (1962); Arthur T. Ippen (1960), Eivind Hognestad (1963), and Thomas J. Fratar, *Cont. Mem.* (1960).

Standards: Alfred W. Sawyer, *chairman;* Miles N. Clair, Maurice Quade, and William S. La Ronde, Jr.

Technical Procedure (all terms expire October 1960): Lloyd D. Knapp, *chairman* (chairman, Com. on Division Activities); Charles B. Molineaux, *vice-chairman;* John E. Rinne, Daniel B. Ventres, Thomas J. Fratar, Charles W. Britzius, Elmer K. Timby, Samuel S. Baxter, Woodrow W. Baker, Philip C. Rutledge (chairman, Committee on Publications), Clarence A. Willson (chairman, Committee on Standards), Harold B. Gotaas (chairman, Committee on Research), and the respective chairman of the executive committees of the Technical Divisions.

The Technical Division contact members for 1959-1960 are:

Air Transport and Highways ..... Thomas J. Fratar
City Planning and Construction ..... Woodrow W. Baker
Engineering Mechanics and Structural ..... Elmer K. Timby
Hydraulics and Sanitary Engineering ..... Samuel S. Baxter
Irrigation and Drainage and Pipeline ..... John E. Rinne
Soil Mechanics and Power ..... Charles W. Britzius
Surveying and Mapping and Waterways and Harbors .. Daniel B. Ventres

New appointments to the Task Committees follow:

Liaison Committee on EJC Water Policy: Carey H. Brown, *chairman;* Wallace L. Chadwick, *vice-chairman;* George W. McAlpin, Mercel J. Shelton, and I. C. Steele.

George Washington Memorials: U. S. Grant, III, *chairman;* Carl G. Paulsen, *vice-chairman;* Daniel C. Walser, and Frank L. Weaver.

Public Relations Film: R. Robinson Rowe, *chairman;* John E. Rinne, and Robert H. Sherlock.

Professional Development: Lauress L. Wise, *chairman;* Edwin H. Gaylord, Jr., Nomer Gray, and Clarence L. Eckel.

New appointments to the Joint Committees will be listed in February.

(*More ASCE News on page 80*)

HIGHWAY PROGRESS AROUND THE WORLD

ROBERT O. SWAIN

Executive Director

International Road Federation

Washington, D. C.

The five-bridge crossing of the Jacui River constitutes one of the most ambitious road and bridge programs ever undertaken in the southern part of Brazil. Photo locates (1) Jacui Bridge, 5,770 ft long; (2) Alemoa Bridge, 2,549 ft long; (3) Furado Grande Bridge, 1,138 ft; (4) Guaiba Bridge, 1,860 ft; (5) Guaiba Overpass, 5,965 ft. Total length of structures is 3.28 miles.

Nicknamed "El Tapon" (The Stopper), this 25-mile section of the Pan American Highway in northern Guatemala has become famous in road-building history. Closed at least three times by landslides after it was graded, it is now open once again to traffic. Here, a Caterpillar crawler tractor fills a ravine with dirt.

Indicative of the amazing progress in highway development throughout the world area:

- **A study concerning the feasibility and desirability of a tunnel under the English Channel**
- **A five-year program in the Province of Buenos Aires, Argentina, for which about $100 million will be spent**
- **The construction of a 7.5-mile tunnel between France and Italy under Mont Blanc, Europe's highest mountain**
- **A five-year toll-road program started in Japan in 1958 calling for the construction of 336 miles of new toll roads at a cost of $420 million**

"Amazing" is an appropriate term for describing the progress that has been made in the fields of highway development and highway transportation on a worldwide basis since the end of World War II. It is amazing to realize that today the proportionate increase in road expenditures in foreign countries actually exceeds that in the United States. This is so despite our spectacular Interstate Highway program.

For example, highway expenditures increased some 38 percent in the United States from 1955 to 1958. However, the free-world countries not including the United States showed a 95-percent increase for the same period. These expenditures were for new construction, maintenance and operation at federal, state and urban levels. In 1958 expenditures for highways in the free-world countries totaled $17.13 billion, of which $9.93 billion was spent in the United States.

An average annual increase of 15 percent in highway expenditures has prevailed for the past eight years. If this rate continues, the total highway expenditures in the free world in 1965 (including the United States) will total $45 billion, or over twice as much as the 1958 level.

The tremendous impact of the highway development program in advancing social and economic improvements throughout the world cannot be overestimated. Some nations with large areas of fertile soil previously had to import foodstuffs from as far away as 1,000 miles. These nations are now finding that highways open up new areas, not only for agriculture, but also for the exploitation of petroleum and mineral resources. They have come to realize that only highways provide the international distribution system so basic to all economic development.

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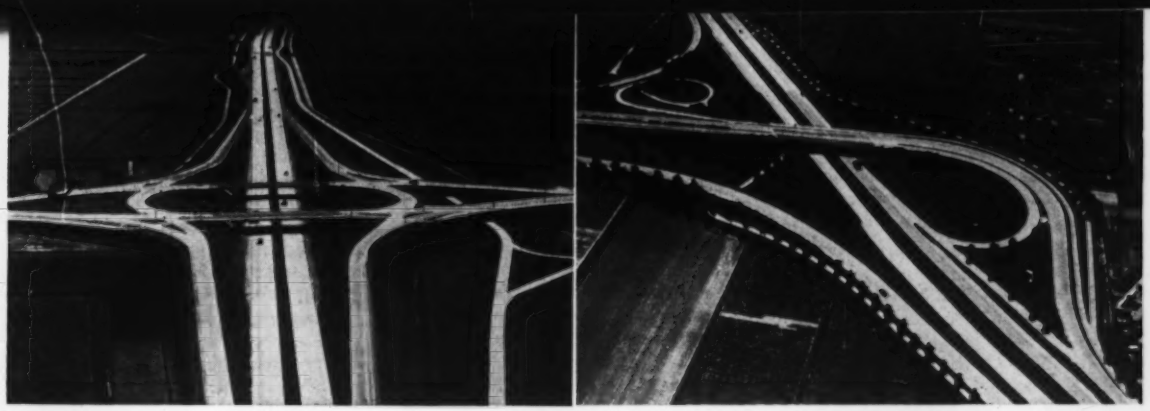

Typical of the many advances being made in the highway field in the Netherlands are these two modern interchanges. At left is the intersection of the Amsterdam-Utrecht Motor Road with the circular route around Amsterdam. At right is the junction of Routes 15 and 16 in the vicinity of Ridderkirk near Rotterdam.

Also, these nations have grown to recognize the flexibility of highway transportation. The International Road Federation, for example, has affiliated good roads associations in over 65 countries. These organizations, composed of civic, governmental and professional leaders, devote themselves entirely to promoting road consciousness within their countries and to accelerating the road program.

Certainly a major factor in promoting the great surge in foreign highway programs is the outstanding work of the U. S. Bureau of Public Roads and American consulting engineers and contractors. All these groups are spreading to the far corners of the world, building highways and airports and training personnel. Also, the exchange program of the International Cooperation Administration has helped in the worldwide exchange of technical personnel. The scholarship and training programs of the IRF and its general distribution of technical information have also contributed materially to foreign highway programs.

Two other factors are basic in the consideration of the remarkable road progress overseas. The first is the sound planning being carried out in many countries for the development of highway programs and for the facilitation of highway transportation. The plans for many of these countries are being made by highway engineers who have studied in American universities under the sponsorship of the IRF. This program, which has been going on since 1949 and has included engineers from more than 60 countries, has provided an opportunity for some of the world's highway leaders to obtain their Master's degrees at American universities while pursuing their chosen profession of highway engineering.

The other consideration is the intense desire abroad to provide financing for highway plans. Many countries do not depend solely on user taxes. They recognize that construction of a highway system involves a considerable expenditure and that general funds as well as special user taxes must be made available. In addition, loans from such international institutions as the Development Loan Fund, the Export-Import Bank and the World Bank are being wisely utilized.

Another reason why progress on roads abroad is going forward at such a tremendous pace is the utilization of many modern techniques and modern equipment, which make possible the building of roads in rugged terrain. Although it is impossible here to give a step-by-step account of what is being done in the highway field, country by country all over the world, some of the highlights can be touched on.

Highlights of world progress

The Pan American Highway System, of which the Inter-American Highway is a part, extends from Alaska to Buenos Aires and links together almost all the capitals of the Americas. It is pretty well completed from Colombia on through the rest of South America. The main bottleneck in this great hemispheric road network is the Darien section of Panama and Colombia, and work is being done towards the eventual completion of this section.

Today road consciousness does not cease once a highway is constructed. Recently the Ministers of Public Works of all the Central American republics and Panama met in Costa Rica to consider the problem of permanent and uniform maintenance of the Inter-American Highway System.

In Africa, the Capetown-Nairobi road, sometimes referred to as the Pan African Highway, is being reconstructed and improved to provide a dependable highway route through an area of great potential wealth. When this highway is completed, with the required feeder roads, it will serve an area of three million square miles and a population of six million.

An international project in the formulative planning stage is the Pan Arabian Highway System. It is evident that a good highway system, linking the various Arab states in the Middle East, is necessary for their future development.

Europe today has an international system like the Pan American Highway System which links all the capitals of Europe. Several things are going on in Europe at the moment that illustrate the amazing progress in highway development in that area. For example, the IRF is cooperating with a group that

A modern reinforced concrete overpass carries part of the Stuttgart-Munich expressway through southern Germany.

is studying the feasibility and desirability of a tunnel under the English Channel. This is no myth; it may become a reality in our lifetime. Another group is realizing a long-cherished dream by building a tunnel through Mont Blanc. This $30 million project will provide for all-weather traffic and reduce the existing 97.5-mile trip between France and Italy to one of about 8 miles. The tunnel is 7½ miles in length and provides emergency parking areas at 1,000-ft intervals.

A very encouraging sign of progress is in Switzerland, which for years has boasted of having the best secondary road system in the world. In the spring of 1959 ground was broken for the first superhighway in Switzerland, the Geneva-Lausanne Expressway.

Oslo, Norway, and 14 neighboring municipalities have set up a regional planning committee. One of its main assignments is a study of the long-range highway needs of the area. The backbone of the proposed arterial road system for the city of Oslo will be a four-lane divided full freeway running along the waterfront, with an extension due southwest to the city limits. East of the city center it turns northeast to serve the valley of Groruddalen, where most of Oslo's industry is, or will be located.

Austria has two projects of special interest to highway engineers. The Duernstein Tunnel near Vienna was opened to traffic last June. Its 1,550-ft length makes it the longest in Austria. Automatic devices at each entrance control the volume of air for ventilation.

On the Brenner Expressway, the Europe Bridge, with a total length of 2,350 ft and a height of 590 ft above the Sill Valley, is another major undertaking. Consisting of five steel spans and having a maximum pier height of 460 ft, the bridge was designed for wind pressures of 125 mph.

Italy also has used the toll road to help provide many needed highway facilities. Nine toll roads totaling 873 miles, and costing $450 million, are under construction or soon to be constructed.

The 457-mile Milan-to-Naples toll road, known as the "Highway of the Sun," is one of the major projects. To be completed by 1963 at a cost of $300 million, the road will reduce the driving distance between Naples and Milan from 527 to 475 miles. Design speeds of 100 mph were used for the Milan-Bologna sector.

Foreign toll roads, incidentally, usually enjoy at least partial financing from general funds. Bonds issued to provide the additional financing required carry higher interest rates—about 6 to 7 percent—than in the United States.

To the North, in Canada, by the end of 1960 our neighbors will be able to travel from one side of their country to the other over the great 4,470-mile Trans-Canada Highway. Work on this road was started in 1950 and will provide, for the first time, a good east-west all-Canadian route.

Mexico, our neighbor to the south, is making rapid progress in the development of a modern highway network. In 1950 the first Mexican origin and destination survey was made in the city of Monterrey. The first toll expressway came in 1952 with the Mexico-Cuernavaca Highway, the first prestressed concrete bridge in 1953.

In 1958, traffic signs and signals recommended by the United Nations were adopted by Mexico's Federal District and four of its states in an effort to provide uniformity. Traffic engineering curricula for undergraduates were made available at the Universities of Mexico and Puebla in 1954. This year the University of Mexico introduced postgraduate courses in highway and traffic engineering.

In October of 1957, the Brazilian Congress voted to move its federal capital inland. The same legislation authorized a highway to connect the new city, Brasilia, with the country's existing network of paved roads. A 455-mile road was therefore put under construction from Belo Horizonte to Brasilia. This will replace the existing 900-mile zigzag trail between the two cities. The road, with a soil-stabilized base and a bituminous wearing surface 1 in. thick is scheduled for completion by April 21, 1960. Cost of the work is estimated at $36.3 million.

An even more ambitious project is now under construction to connect Brasilia with Belem, at the mouth of the Amazon. The 1,567-mile route will open up almost 2 million square miles of formerly inaccessible areas in the Amazon basin and the central plateau of Brazil.

In Argentina, highway programs in the Province of Buenos Aires are by far the most advanced. The country has prepared a five-year plan, 1959-1963, on which about $100 million will be spent. About $11,000,000 is allocated for purchase of new equipment and spare parts for old equipment.

Other side of the world

Japan has greatly expanded its highway program. From 1954 through 1958 extensive highway improvements were carried out. These included the improvement of about half the primary national highways, a third of the secondary national highways, and 20 percent of the local roads in the country. The Japan Highway Public Corporation was established in April 1956 to take over all highway toll operations, including bridges and ferries, and to undertake all new toll projects. A five-year program started in 1958 calls for the construction of 336 miles of new toll roads at a cost of $420 million. One of the principal toll construction projects is the Kanmon Highway Tunnel between the islands of Honshu and Kyuahu. Its length of 2.2 miles makes it the second longest under-water tunnel in the world.

As a result of the activities of the Highway Research Board and the American Association of State Highway Officials, many countries throughout the world look to the United States for guidance in the development of plans and specifications for their highways. In most countries ASTM tests are specified for the control and testing of materials. This does not mean that they all follow our standards. In some instances both their design and their construction are comparable to ours. This is especially true of the new highway work in several parts of Europe and South America.

In general, maximum limits for vehicle sizes and loads follow the recommendations of the 1949 Geneva Convention. However, enforcement of these regulations is very spotty and in some cases non-existent.

As is to be expected, results of the AASHO Test in Ottawa, Ill., are being awaited with great interest by professional highway engineers all over the world.

In summary, the present era of unrivaled progress in the planning and construction of improved land routes which thread the globe is a heartening one. This is not to say that all problems are solved or that the necessity for continued technical education, financial assistance, research and allied aids from the United States is diminishing. Rather, the bulwark of methods, men and machinery, as well as public and private support, that has been erected in our time must not be allowed to diminish. This great force must continue to grow in direct proportion to the requirements of the emerging nations who, for the first time, are being made aware of the benefits that have accrued to neighbor nations through improved highway facilities and who now wish to avail themselves of similar benefits.

(This article is based on the paper presented by Mr. Swain at the ASCE Annual Convention in Washinton, D. C., before the Highway Division session presided over by C. E. Fritts, chairman of the Division's Session Programs Committee.)

ROAD-SURFACE MAINTENANCE IN MAINE

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Division Engineer

Maine State Highway Commission

Ellsworth, Maine

The lowest type of road surface in Maine that might be considered a pavement is a bituminous treatment applied to a gravel surface. Throughout the state there are 7,700 miles of this type, of which 6,000 miles are on the state-aid system. Much of it has been in place for 30 years, and additional mileage is added each year on secondary roads. This requires a retreatment every other year.

On the older roads, or newer ones carrying heavy traffic, the retreatment consists of a "mulch." This is about 0.3 gal of medium curing tar or asphalt, put on in two applications with 20 to 25 lb of gravel passing a ¾-in. screen. Materials are mixed in place with a grader combined with a mulch drag, which is a frame suspended from a heavy truck. It has short blades set at different angles so that the material is rolled back and forth and thoroughly blended.

After several passes, the number depending on weather, temperature and quality of the gravel, the material is spread to the full width of the pavement, covered with enough sand to minimize "pick-up" and left for traffic to compact. The use of drawn rollers as the last operation seems helpful. Such rollers not only smooth the road and start compaction, but also crush some of the larger particles or drive them into the old pavement, which has been slightly softened by the application of the hot bituminous material. This mulch operation strengthens the pavement and takes out slight irregularities to give a smooth and quiet riding surface.

On newer roads, on those carrying light traffic, or on those mulched the previous year, a seal coat only may be adequate. This consists of about 0.15 gal per sq yd of the same bituminous material, covered with enough gravel to prevent pick-up; it is left for the traffic to roll.

For intermediate-type pavement in Maine, gravel and bituminous material are mixed in place or premixed. This amounts to a "king-sized" mulch, 2 in. thick. Earlier projects were laid with a medium curing tar and gravel not closely controlled as to grading. Some of the mixes appeared to be too dry, with the result that potholes formed during the warmer spells of the winter season. In the past few years, grading control of gravel has been more precise and a medium-curing asphalt, cutback or emulsion, has been used in the mix. Such surfaces can go four or five years without retreatment, as compared with one or two years for the earlier projects.

For the past five years stone sealing has been used on this type of pavement. Between 0.25 and 0.30 gal of RC4 per sq yd is applied to the pavement at a temperature of just over 200 deg. This is covered immediately with up to 25 lb of fresh gravel or quarry stone and rolled with a tandem steel roller. Probably 25 percent of the covering stone is wiped off by traffic; but reducing the original application by that amount seems to give inferior results. Surfaces using the crushed quarry stone look excellent after five years; some of those made with crushed gravel do not.

High-type pavements

Thirty years ago, Maine built many miles of road of portland cement concrete. Much of this has now been covered with various types of bituminous surface. Original construction joints still show through and are filled with RS1 and sand every spring. Settlement cracks do not show through.

Maine has 490 miles of bituminous macadam. Some of the older sections have been stone sealed as previously described. Some such pavements have had no surface maintenance in their ten years of life; others may have had no attention for a longer period. Some patching is done to correct small depressions. Settlement along the edges of the pavement, caused by heavy wheel loads too near the earth shoulder, is corrected by mulching to a true crown before the summer stone sealing is done.

Most of the high-type pavement now used on heavily traveled highways is bituminous concrete. It can be applied with minimum inconvenience to traffic, gives a smooth surface and a quiet ride and has good durability. There is some question whether the current type, using crushed gravel in most cases, and having a tight surface, is as durable as an older type that used quarry stone and had a more open surface texture. Some of the newest sections are among those that need sand first during snow storms.

Bituminous concrete used over old

Small distributors are used by the State of Maine for surface-treatment maintenance on more lightly traveled roads.

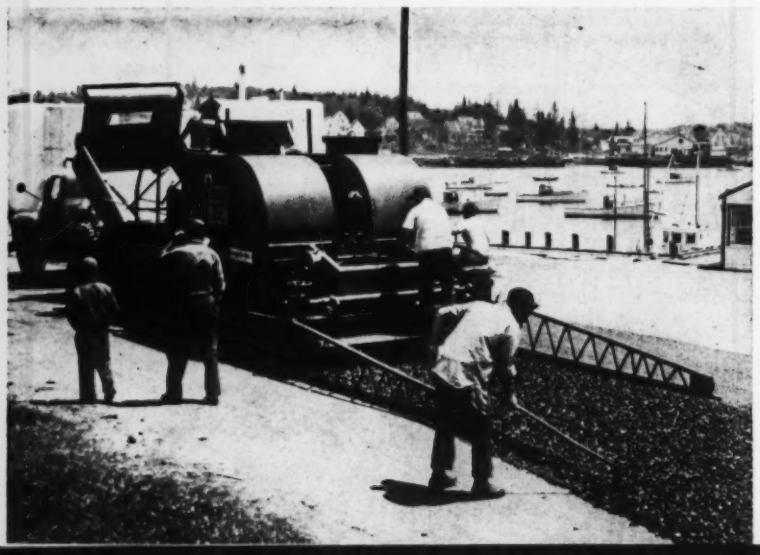
portland-cement concrete requires annual crack-filling. Pavements laid on a gravel base may show irregular cracking after one or two winters, except for the very newest projects. This appears to be the result of base settlement. However, paving over a section of mixed bituminous material eight or more years old, which had never shown similar cracking, did show this typical cracking after one winter. Traffic seems to have no appreciable effect on the cracks. They are filled with RS1 emulsion and sand but they remain as evidence of patching until the entire pavement is resurfaced.

Maine uses nearly 5 gal of asphalt products to 1 gal of tar. This is for the very good reason that 2 gal of asphalt products can be obtained for the cost of 1 gal of tar. As city gas plants have been replaced by pipelines carrying natural gas, the amount of tar by-product has decreased. More of the asphalt by-product is available from refined petroleum. Since the end result per gallon of material is about the same, the material that costs the least is used. In fiscal 1958 the Maine Highway Commission purchased:

Asphalt emulsion	914,875 gal
Asphalt cutbacks	10,573,188 gal
Tar	2,699,227 gal
Total	14,187,290 gal

More than 60 percent of Maine's summer maintenance money goes into roadway surfacing operations. The second most costly duty during the summer is roadside maintenance. This does not mean roadside beautification. It includes ditching, guard rails, bushes and grass, culverts, and the picking up of beer bottles and other litter. More roadside spraying is beginning to be done to control plant growth, but it will be some time before real results are apparent.

Motor paver of Maine's Highway Department applies a pavement of permanent type on a maintenance project.



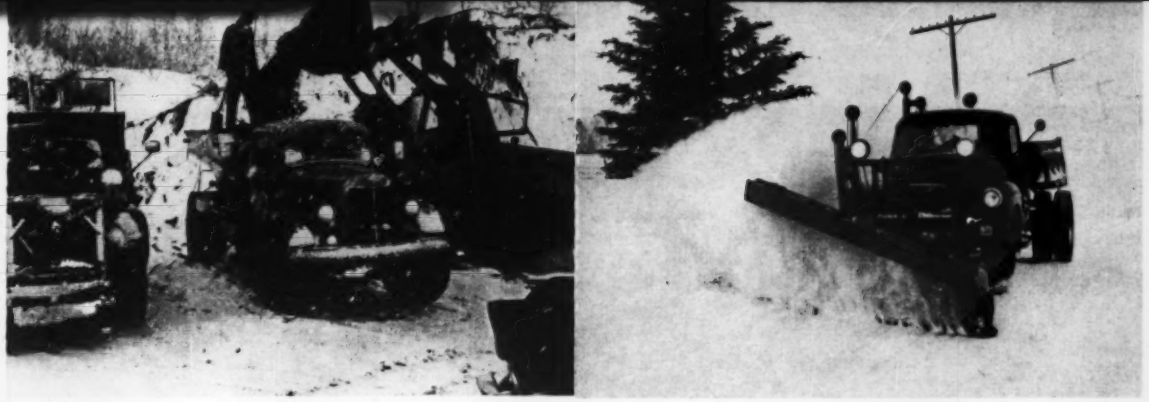
In Maine, a mile of ditching seems to be worth a half mile of tar. This means that a well-ditched roadway will go a longer time between full surface treatments. Replacement of culverts is a never-ending duty. Some waters will destroy the bottom third of a galvanized pipe in less than 20 years. In other cases such pipe may go nearly 40 years before it collapses. Many such culverts in Maine are well along into their third decade.

Shoulder maintenance also costs heavily. Maine has gravel shoulders along many miles of surface-treated gravel and old mixed bituminous and macadam roads. The big problem is to keep the shoulder material level with the pavement. The preferred method is to use two graders in tandem. The first pulls the material up against the pavement, leaving some on the surface. The second grader, following a few hundred feet behind the first, sweeps the excess off the road surface. There are attachments that may be fitted to the first grader to eliminate the second grader when the excess material is not heavy. Maine does not often enjoy the luxury of having two power graders available for such jobs, so homemade devices and shoulder-drags have been utilized.

Treated shoulders are used for a width of 2 ft along the edge of intermediate and high-type pavements. These shoulders contrast with the pavement in texture but get the same routine sealing treatment applied to low-type pavements. Outside the 2-ft treated width, a gravel shoulder is maintained as previously mentioned.

A well-maintained guard-rail can make an otherwise second-rate roadway look presentable. Nothing looks worse or draws more adverse criticism than a poorly aligned or poorly painted rail. At the end of two years the paint is rubbed off by snow pushed against it, unpainted posts have been substituted for those broken in accidents, and the tops of the posts begin to lean toward the woods. Steel H-beam posts have advantages but the perimeter for painting is 28 in. as compared with 22 in. for a 7-in. wood post. Steel posts are neither unbreakable nor unbendable. Possibly treated wood posts would be the answer. They are far from handsome but they do not rot nor do they need painting. They seem to take blows that would ruin a cedar or a steel post and remain usable. Guard-rail posts should be reflectorized.

In winter Maine's highways are



Paver loaders (above) are used to fill hopper trucks with sand, also to load salt into trucks equipped with mechanical power-driven spreaders. Blade plows on light trucks (right) are used in all parts of Maine—in the southern and central sections generally alone, in the western and northern sections teamed with the larger V-plows.

plowed by state crews, by independent contractors on a mileage basis, and by equipment hired on an hourly basis as needed. Plows are started out when about 2 in. of snow has fallen and are kept going throughout the storm and until the snow has been pushed beyond the shoulder break after the storm. A section 12 to 15 miles long is scheduled as a unit. Except during bad storms, this permits the average motorist with snow treads, or even with good ordinary tires, to proceed at a speed perhaps 15 mph below his ordinary rate of travel.

Plowing is done generally with one-way blades with wings on a light or medium truck. The idea is to keep the snow accumulation down by frequent trips rather than to handle a heavier load at longer intervals, using larger units. It is more important to get the snow off the pavement than to throw it into the fields. The blades are operated close to the surface with resulting wear on the cutting edge rather than on the shoes. Power graders, using the regular grader and attached wings, fit well into this type of work. On the newer roads, with a true surface and wide shoulders, they surpass all but the best blades for effective clearing. Some V-plows and a few blowers are used, mostly in the northern sections of the state and in some mountainous areas.

Plowing is no longer the bugbear of winter work. To some operators, it is a game in which they are pitting their skill and stamina against the elements. They have good equipment, a warm cab, and unless plagued by faulty lights or a balky windshield wiper, can go for hours over a familiar section of road.

Sanding is another story

During October, about 200,000 cu yd of sand is stockpiled in units of several thousand cubic yards each—at road intersections where a power shovel can be made available to load as needed. As the material is stockpiled, about 100 lb of rock salt per cu yd is added and mixed in.

When the report of an approaching storm is received, all crews are alerted. They may eat an early meal and fuel up their trucks, or a few may be sent home to get some rest if it appears that the storm may last a long time. Almost invariably the first attack is delivered by sand trucks sent out to treat hilly stretches of road which experience has indicated will become dangerous. This includes slopes of 6 percent or steeper. The sand trucks go out before the plowing starts. In hilly country the first application of sand will remain after several trips of the plow, and the spinning wheel of a vehicle will cut down to the grit—on the pavement, where it belongs.

If it is a "warm" storm or if the fall of snow is expected to be light, spreaders sometimes go out with raw salt. Salt is not an abrasive. It works best in flat country where traffic is heavy enough to spread it widely.

A little calcium chloride is used. At low temperatures, 10 to 20 percent may be added to the rock salt to cut ice in hazardous areas. Sand that has been stockpiled several weeks with the regular blend of salt, with more salt or calcium mixed into it, seems to do the best job during extreme cold for small patches of ice. Possibly the dampness of the sand makes it adhere to the ice long enough for the salts to start acting.

Spinner sanders are used; one or two men stand in the dump body to feed the sand at a steady rate through the tailgate onto the spinner. Some hopper-type spreaders are available; these permit spreading of a 7-cu yd load with only the truck driver to handle it. The disadvantage of this arrangement is that the trucks now owned cannot be used for hauling and dumping at other times. Tailgate spreaders are said to be available that are traction driven, under accurate control of the driver; they can be attached and left on all season and do not prevent rear dumping. They would avoid the necessity for men to work in the back of the truck body.

Snow fencing is a necessary item where drifting occurs. Erection and dismantling of snow fences is not a large item when compared with the cost of plowing and sanding. It is not practicable to use a snow fence where it would be needed for the full length of the road to give appreciable benefit. An additional plow would be cheaper. The posts are erected early in the fall and the fence attached after the ground freezes.

A relatively new service to Maine highway users is the night patrol. Traveling in radio-equipped pick-ups, the men report weather and road conditions and assist stranded motorists. They may supply a gallon of gas or haul a car from a ditch. They carry a small supply of sand to cover areas where water has flowed across the road and frozen. The night patrol brings more letters of appreciation from pleased taxpayers than any other service performed by the highway commission.

In five years, total snow removal costs in Maine have increased 60 percent, from $3.08 million to $4.9 million. The increase is almost entirely due to public demand for better road conditions during the winter. It is now a rare occurrence when chains are needed on the state highways. The 1958 report of the State Highway Commission contains this terse paragraph:

"A decrease in the cost of this [snow handling] activity cannot be expected with the public demand for pavements free from snow and ice during and immediately after storms."

Maine's Highway Department is continually improving not only its procedures and equipment for dealing with a great deal of snow and ice during the long winter season, but also its mileage of improved roads to make travel throughout the state easier and safer.

Ski jumps at Squaw Valley

DANIEL SHAPIRO, M. ASCE, Structural Engineer (and Project Engineer for the ski jumps)

John Sardis & Associates, San Francisco, Calif.

The Olympic ski jumps in Squaw Valley, Calif., presented their designers and builders with many interesting problems. The profiles were designed by Heini Klopfer, German ski jumper and world's foremost designer of ski jumping facilities. The jumps are part of the overall building and site development program undertaken by the State of California for the 1960 Winter Olympic Games.

The layout called for two parallel jumps—a 60-meter and an 80-meter jump (about 197 and 262 ft). See Fig. 1. The "size" of a ski jumping hill is the distance measure of a theoretically perfect jump. This length is measured on the slope from the point of take-off to the point of landing. Later a non-Olympic 40-meter practice jump was included in the program and was laid out parallel to the other two jumps. The jumps are on a natural jumping hill, the type of area always sought but seldom found, and therefore two unusual features were included in the layout: (1) All three jumps employ a common outrun so that the landing slopes for the three jumps are the same; (2) no superstructure was used to achieve the steep slope required on the inrun, and as a result it was necessary to provide embankment fills with surface slopes as steep as 39 deg (81 percent).

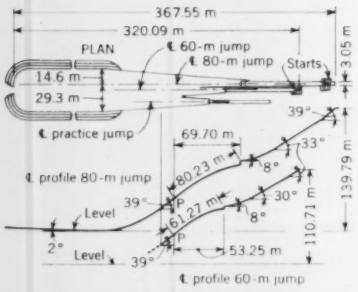


FIG. 1. On plan and profile of ski jumps, "P" indicates "critical point," the theoretical point on the landing slope for a perfect jump.

The length of the jump is approximately 1,100 ft, measured horizontally from the highest starting structure to the end of the outrun. About 400 ft of this is practically level outrun with the remaining 700 ft cut into an accurate profile and rising 420 ft up the mountainside. The deepest cut required occurs above the take-off structure about midway down the inrun and is roughly 25 ft deep. The deepest fill occurs about midway on the landing slope and is also about 25 ft deep. Both the cut and the fill at their widest points are about 150 ft across.

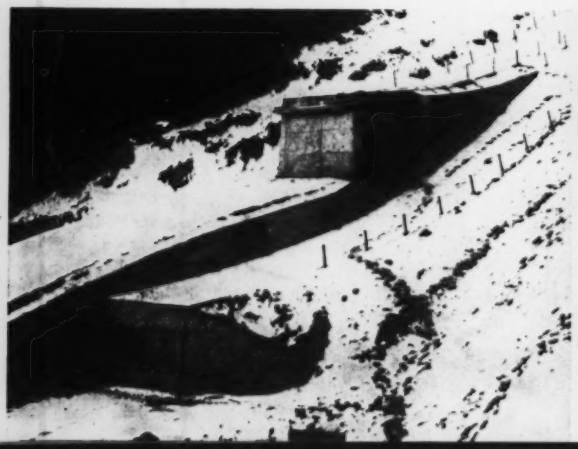
Inasmuch as the 80-meter (or "big jump") and the 60-meter (or "small jump") have different lengths of inrun and profiles, it was necessary to build a retaining wall 165 ft long between the two jumps. This wall, which varies from zero to 15 ft in height, is a standard reinforced-concrete cantilevered retaining wall with foundation material varying along its length from solid rock to an engineered fill 4 to 5 ft deep.

Concrete was also utilized for: (1) construction of the big jump take-off structure, which serves also a storage room for maintenance equipment; (2) a retaining wall for the small jump take-off platform; and (3) the starting platforms at the top of the inrun for both jumps.

Except for a small fill at the extreme top of the inrun for the big jump—where the slope had to be raised above the existing grade to a slope of 39 deg—the engineers achieved a balance of cut and fill material wherever possible to avoid hauling fill material to higher locations. The cut and fill balanced out at about 18,000 cu yd, with a slight excess of cut over fill. The bulk of the fill was downhill from the cut.

After the contractor had completed the uphill cut, he began to place the fill at the bottom of the outrun. Since the natural slope was approximately 30 deg and the final landing slope sur-

Upper and lower structures in photo at left are for 80-meter and 60-meter jumps respectively. Upper structure houses an equipment storage room. Tunnel at lower left is a pedestrian cross-over. View from the 80-meter jump structure, at right, shows a competitor in full flight, with end of outrun at the bottom of the slope.



face is at 39 deg, this was the most critical part of the job and the most difficult problem for the designers to solve. The bulk of the fill had to be placed above the extreme natural slope of 30 deg and had to be able to withstand the most severe extremes of weather. An additional complicating feature was the existence of a spring at the toe of the slope. The engineers departed from the traditional end-dump methods used for placing fills on past jumps and called for a highway type of embankment fill with 90-percent minimum compaction and a maximum tolerance in grade of 0.2 ft. The fill was worked up from the bottom in 12-ft widths by benching into the hill and then compacting the fill material in place in thin layers until it was high enough to reach the next bench.

The entire cutting and filling operation was done under the direct supervision of Dames and Moore, soils engineers, representing the engineers, John Sardis & Associates.

Almost all the concrete was brought to the site in transit-mix trucks which labored up to the hill to a point higher than the pour. In many cases, because of limited access, this would be at a point that seemed much too high, or not quite high enough. In either case the concrete was delivered to the pour by metal chutes. To prevent segregation during the long steep slides, the concrete was kept quite stiff, and although conditions appeared extreme at times, the operation was successful and the concrete work was excellent.

To keep the snow from sliding during the winter sports season, and to act as drains at other times, redwood keys were provided across the 39-deg slopes. In addition, because of the very steep slope of the inrun and outrun, the engineers felt it necessary to devise a means of mechanically stabilizing the surface material to prevent it from sloughing off. Therefore the redwood keys were incorporated in a mat made up of redwood headers running parallel to the centerline of the jump on 10-ft centers. The headers intersect the redwood cross-members at a spacing of about 4 ft on centers. Headers and cross-members are held in place by galvanized welded wire mesh. Drainage ditches and small culverts are so placed as to carry off any surface water that may threaten the jumps, and all surfaces not otherwise protected are slated to receive planting for erosion control.

Expanded design charts for concrete pavement

FRANK McCULLOUGH and WILLIAM B. LEDBETTER, Members ASCE, Senior Engineering Assistants

DAVIS L. FORD, M. ASCE, Engineering Assistant; Texas Highway Department, Austin, Tex.

Two widely used design charts for the thickness of unreinforced jointed pavement of portland-cement concrete were included in the Portland Cement Association's 1951 manual entitled *Concrete Pavement Design*. The charts were developed from the following semi-empirical formulas for two different conditions:

For protected corners:

$$S = \frac{3.36\,P}{d^2}\left[1 - \frac{\sqrt{a/L}}{0.925 + 0.22\,a/L}\right]$$

For unprotected corners:

$$S = \frac{4.2\,P}{d^2}\left[1 - \frac{\sqrt{a/L}}{0.925 + 0.22\,a/L}\right]$$

in which:

S = maximum flexural stress at corner of slab, in a direction parallel to the bisector of the corner angle, due to a wheel load of P lb, psi

P = wheel load placed at slab corner, that is, the static wheel load, increased by a factor to provide adequate allowance for impact of moving loads, lb.

d = thickness of a concrete slab of uniform thickness at a corner (or equivalent thickness of a thickened-edge slab), in.

a = radius of circular area equivalent to contact area of tire with the pavement (with parameters taken from data presented in Fig. 8, PCA Manual on *Concrete Pavement Design*), in.

L = radius of relative stiffness defined by the equation:

$$L = \sqrt{\frac{Ed^3}{12(1-\mu^2)\,k}}$$

E = modulus of elasticity of the concrete, assumed to be 4,000,000 psi

μ = Poisson's ratio for the concrete, taken as 0.15

K = modulus of subgrade reaction, psi per in.

Since the publication of this manual, designers have encountered moduli of elasticity other than 4,000,000 psi, and as a result have had to discontinue use of the charts and go back to the more time-consuming formulas.

To overcome this limitation of the charts, by expanding them to include various moduli of elasticity, the writers have developed the accompanying Figs. 1 and 2. This expansion was accomplished by first computing the required thicknesses from the formulas for moduli ranging from 1,000,000 to 5,000,000 psi, and then plotting them on the charts in the form of nonlinear thickness-determination scales.

To use the charts, five variables must be determined. The first is the type of load transfer device to be used across the joints. This will determine whether the chart for the unprotected corners (Fig. 1) or that for protected corners (Fig. 2) should be used. Second, the maximum flexural stress is found by determining the desired modulus of rupture and modifying it by a suitable safety factor to eliminate the fatigue effects of repetitive traffic loads. Next, Westergaard's modulus of subgrade reaction, K, should be found for the existing subgrade soils. (See H. M. Westergaard, "Stresses in Concrete Pavements Computed by Theoretical Analysis," *Public Roads*, April 1926, vol. 7, no. 2, pp. 25-35.) Fourth, a design wheel load, P, is selected af-

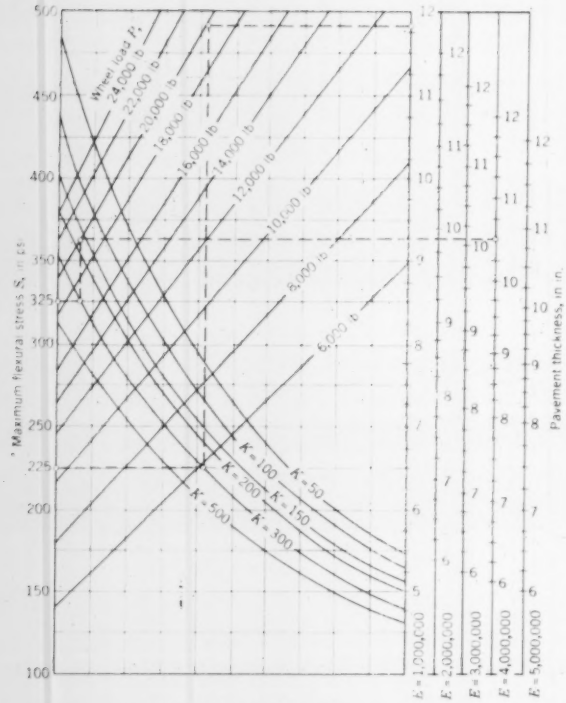


FIG. 1. Design chart for jointed concrete pavement, unprotected corner.

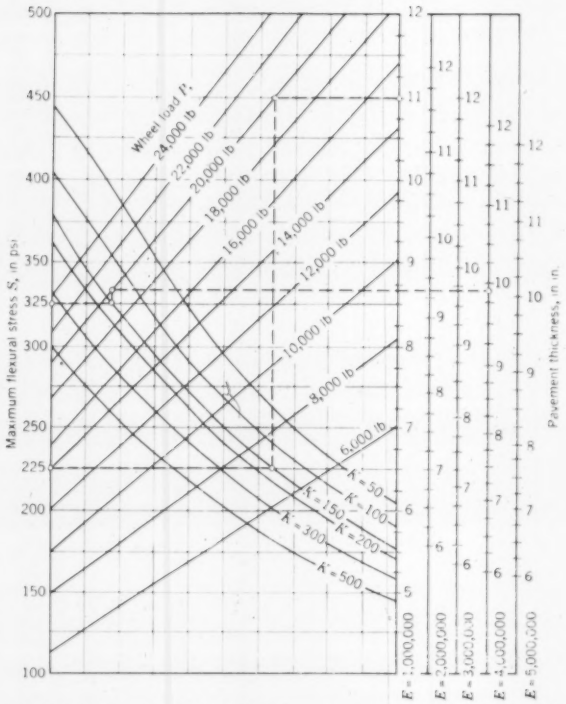


FIG. 2. Design chart for jointed concrete pavement, protected corner.

ter considering such factors as traffic and loadometer data, and impact allowances. These charts were computed for wheel loads on dual tires with the dimensions of the loaded area as recommended by the Portland Cement Association and incorporated in its manual. Finally a design modulus of elasticity, E, is selected for the concrete. This modulus, usually the static modulus of concrete in compression, should be found for each particular modulus of rupture (flexural strength) selected, using whenever possible the materials from which the final concrete will be made. A proper balance between E and S should be sought, to arrive at the most economical design.

With these variables determined, the required design pavement thickness can easily be found through the use of the accompanying charts.

Example 1. The five variables are considered to have been determined as follows:

Joints, unprotected corner

$S = 325$ psi (650 psi for the modulus of rupture, divided by a safety factor of 2.0)
$K = 300$ psi per in.
$P = 20{,}000$ lb (a wheel load of 16,000 lb plus 25 percent for impact)
$E = 4{,}000{,}000$ psi

The required pavement thickness, from Fig. 1, is found to be 11 in. (to the nearest inch).

Example 2. Here the five variables are taken as:

Joints, protected corner

$S = 225$ psi (450 psi for the modulus of rupture, divided by a safety factor of 2.0)
$K = 150$ psi per in.
$P = 20{,}000$ lb
$E = 1{,}000{,}000$ psi

From Fig. 2 the required pavement thickness is found to be 11.0 in.

The increased versatility of these revised charts will save time for the highway engineer.

THE READERS WRITE

A challenging report on the younger engineers

To THE EDITOR: The Los Angeles Section of ASCE has presented the profession with a most succinct and lucid analysis of the dominant ideas and motivations current among the younger civil engineers who have not yet become disenchanted with their profession. I refer to the Final Report of the Committee on Engineering Education of the Los Angeles Section, which appeared in condensed form in the October issue, vol. p. 734.

It is my earnest hope that this report will be read and pondered by the officers of ASCE and all others interested in the welfare and vitality of the Society.

As a registered professional engineer in the consulting business, I can readily recognize the honesty and factual quality of this report of a thorough investigation into the opinions and status of the young-

er men. The entire report must represent a great deal of work and enthusiastic dedication by several men. It is to be fervently hoped that their efforts will not go unappreciated and ignored.

May I congratulate the originators of the report and urge all thoughtful members of the Society to carefully digest its significance. Failure to do so may easily mean a future decline both in the importance and in the influence of our venerable organization.

RICHARD Z. ZIMMERMANN, JR., M. ASCE
Structural Engr.,
Albert C. Wood Assocs.,
Radnor, Penna.

Prestressed concrete piles given a 3-in. cover

TO THE EDITOR: In the very interesting article on "Prestressed Concrete in Marine Structures," by Ben C. Gerwick, Jr., F. ASCE, in the November issue, attention is called to the following statement on vol. p. 785:

"American practice for piling almost universally requires a 2-in. cover. However, a 2½-in. cover has been used in Los Angeles Harbor and some other areas."

On page 28 of the Portland Cement Association's booklet on Concrete Piles it is stated, "for severe exposures, as in sea water, etc., a clear cover of 3 in. is recommended at least for the portion of the pile where such exposure is encountered."

The writer has cast many piles for the Los Angeles Harbor Department, and also designed many thousands of piles, for all of which, when exposed to sea water and sea air, a 3-in. cover was specified.

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Consulting Engineer
Long Beach, Calif.

Maximum deflection at mid-length of a column

TO THE EDITOR: With much interest and surprise I have read the letters to the editor under "The Readers Write" head in the November issue (vol. p. 799), commenting on my article, "Determining the Lateral Deflection and Permissible Loads on Columns," in the October issue (vol. p. 714).

To reply generally to the main arguments raised by the discussers the following three main points must be made:

1. The article does not claim that an equation is derived for the lateral deflections throughout the elastic curve of the column under consideration but only for the maximum deflection at its mid-length. See assumption No. 4 in the second paragraph and the derivation of Eq. 6 under the heading, "Equation for Maximum Column Deflection."

2. Equation 6,

$$d = \frac{1}{2}\sqrt{L^2 - \frac{\pi^2 EI}{pf}}$$

containing the empirical factor of safety f (introduced in Eq. 2), furnishes therefore a solution for the maximum mid-length deflection d.

3. In following the derivation of Eq. 12,

$$\frac{P}{A} = \left(\frac{c\pi^2 k}{f} + \sqrt{\frac{c^2\pi^4 k^2}{f^2} + 16\,L^2}\right) \times \frac{r^2 F}{2cL^2}$$

it should be obvious to the reader that it was not necessary to drop from under the radical sign the term $16\,L^2$ in order to compare it with the empirical AISC formula, $17{,}000 - 0.485\,L^2/r^2$. This is clearly indicated in Table I, entitled "Equation 12 for P/A is compared with AISC formula." By dropping the term $16\,L^2$ (relatively small), resulting in

$$\frac{P}{A} = \frac{F\pi^2 kr^2}{fL^2}$$

the computations for P/A were thereby simplified for purposes of comparison, the closeness of numerical values of P/A by the two formulas thus substantiating the validity of Eq. 12.

Note that the factor of safety, $f = 2$, was used by the writer to correspond with the AISC value, thus verifying its adoption in Eq. 12. However, the values of f to be used in Eq. 12 may not always correspond with those adopted for other empirical formulas.

DONALD BREGMAN
Los Angeles, Calif.

On the lubrication of steel-pile interlocks

TO THE EDITOR: It was surprising to find in our own Society journal (November issue, vol. p. 773) a photograph and note apparently commending the use of diesel fuel oil to lubricate the interlocks of steel sheetpiling.

Since the bending strength of a wall of interlocked steel sheetpiling is dependent upon the degree of rigidity of the interlock connection, it is surely desirable to develop as much friction in the interlock as is practicable, and as is consistent with driving requirements, rather than the reverse. Even when the piling is used in circumferential tension (in cellular wall designs), the use of a lubricant in the interlock is of very questionable value; for straight wall construction it is the antithesis of good practice.

ROBERT F. LEGGET, F. ASCE
Director, Div. of Bldg. Research
National Research Council, Canada
Ottawa, Canada

"The Engineer in Fiction"

TO THE EDITOR: A letter in the October issue (vol. p. 717) from Herbert S. Grassman, F. ASCE, expressed gratifying interest in my article, "The Civil Engineer in Fiction," in the August issue, vol. p. 544.

Mr. Grassman mentions F. Hopkinson Smith as an author I neglected to include. The particular book he has in mind is probably *Caleb West, Master Diver* (Houghton, Mifflin, 1898). Specific mention of this book, along with about a dozen others qualifying as engineering "adventure stories," was omitted because of space requirements. Perhaps the fact that Mr. Smith was an engineer as well as an author should have entitled him to special mention.

I am grateful to Frank B. Campbell, F. ASCE, of Vicksburg, Miss., for calling to my attention Lenore Wilsey's novel, *Still Jim* (A. L. Burt, 1915), and to T. E. Crowley, A.M.I.C.E., of Middlesex, England, for introducing me to the works of Morley Roberts. I would be happy to hear of any other novels or short stories I might have overlooked.

S. C. FLORMAN, M. ASCE
Vice President, Kreisler-Borg Construction Co.
White Plains, N. Y.

James River Bridge on the Virginia Turnpike

TO THE EDITOR: The article, "Hammerhead Piers Carry Turnpike Bridge," by D. B. Steinman and the writer, in the November issue (vol. p. 774), should be corrected on two points regarding the substructure construction.

The 7-ft 9-in.-diameter concrete columns of the piers were poured in lifts of 32 ft without guying over land, although lifts of 16 ft were used over the James River.

The retarding densifier was used for all tremie concrete and deck concrete, but not for all concrete on the project.

C. H. GRONQUIST, F. ASCE
Assoc. Engr. with D.B. Steinman, Consulting Engr.
New York, N. Y.

An error corrected

TO THE EDITOR: My article, Multipurpose Investigation of the Blue Nile," in the October issue, contains an error that I would like to correct.

Dr. Haile Giorges Workneh, A.M. ASCE, Director of Ethiopia's Department of Surveys and Water Resources, is a graduate of the Carnegie Institute of Technology rather than the Massachusetts Institute of Technology, as stated in the article (p. 41).

ALFRED R. GOLZÉ, F. ASCE
Asst. Commissioner, Bureau of Reclamation
Washington, D. C.

The Younger Viewpoint

Younger Member—What Now?

MARY E. JESSUP, News Editor

This article takes the place of "The Younger Viewpoint" in this issue to provide a bit of background for the study of Younger Member activities being conducted in this column each month under the auspices of the Committee on Younger Member Publications. The article goes back to the start of "Civil Engineering" in October 1930, when there were 2,329 Juniors in the Society—who could not vote, who could not hold office in the Society or Sections, who were rarely represented on committees, who had little, if any, place on Section programs, and who attended meetings, if at all, with the idea of being "seen and not heard."

In present-day society the position of the Younger Member is likely to be a bit anomalous—at once privileged and precarious. The Younger Member is likely to find himself the victim of too much attention and too much neglect, of too much praise and too much criticism. Sometimes too much is expected of him, and at other times not nearly enough is expected of him.

In organizations like ASCE, happily, the position of today's Younger Member seems to be markedly superior to his position in the outside world. Perhaps mutual professional interests and ideals help to break down the barrier of age differences. Whatever the reason, one of the very fortunate aspects of ASCE functioning today is the cooperation—instinctive and unquestioning—of younger and older members in the Local Sections, on technical and professional committees, on meeting programs, and in many other phases of the Society's work.

In studying the changing and developing role of the Younger Member in ASCE—as revealed in thirty years of Society News, Letters to the Editor and articles—one is impressed by the give-and-take in today's relationship between older and younger members and by the lack of self consciousness. No doubt younger and older members have always wanted to understand each other and work together, but thirty years ago they were handicapped by mutual feelings of diffidence. The onus of "getting along" was often put on the Younger Member.

In discussing "What the Society Can Do for the Junior Member" in the January 1931 issue (page 333), a Junior suggests the formation of an "advisory board of older members for such Juniors as may seek professional advice." He modestly adds, "By advice I do not mean time-taking discussion, merely an opinion that will show the young member a way out of a difficulty on a certain job that an older head would see in a moment." The same correspondent wistfully asks if it wouldn't be possible to "add one dinner dance a year to the social program of the Sections . . . Then we [the Juniors] could have a winter formal and a summer informal, making the social sessions only a half year apart instead of a year."

Though there were 2,400 Juniors in the Society when this letter to the editor was written, there were few programs for them. Several Sections were thinking about Junior Forums, but none were actually in operation. The Sections were concerned, then as now, with attracting and keeping Juniors, but the idea of programs specially geared to Younger Member interests and needs had apparently not occurred to most of them.

Writing on the establishment of the Los Angeles Junior Forum in the October 1932 issue (page 656), a Junior noted that there would no longer, in that Section at least, "be cause for complaint that Juniors should be seen and not heard." Says the young author, Juniors are reminded of that saying when affiliated with Sections that have not provided places on programs for them."

In a piece entitled "A Word to Junior Members" in the same issue, E. N. Noyes, chairman of the ASCE Committee on Juniors, reminded the young men that while they were "naturally somewhat diffident" about introducing themselves "to older members and hesitant about joining the groups always to be found in friendly conversation at Society meetings," they must realize "that there is also a feeling of embarrassment on the part of the older members in trying to make the acquaintance of the Juniors, a wondering if the young engineer would be interested in those things dear to the heart of the older members of the Society." The young men were advised to try "to meet the older members at least half-way in getting acquainted," and to call on the older members in their vicinity "and develop a speaking acquaintance with them."

In the March 1935 issue (page 189), the Committee on Juniors asked for "constructive suggestions for bringing Juniors into closer touch with the Society." It was felt that "lack of time and funds" was keeping the younger men away from meetings. "Further," it said, "they have not been made to understand the advantages that will accrue to them through Society and committee activities and have not been given the opportunity to prove their worth along these lines." To remedy this, the Committee suggested that "as far as possible a Junior be appointed to each committee of the Local Sections; that each Local Section have an active Committee on Juniors; and that at least one paper at each Local Section meeting be presented by a Junior."

Delving further into the matter in the November 1935 issue (page 721), Prof. J. L. McNew, chairman of the ASCE Committee on Juniors, wrote, "Usually the truth of the matter is that the older members fear the meetings will be uninteresting to the younger men, and the older members are the timid ones. These are all misunderstandings or the result of a mutual timidity or self-consciousness that should not exist. Juniors owe it to themselves and to the Society to attend Section meetings and serve in any and every way they may."

In the November 1938 issue (page 764) Louis E. Ayres, then Director for District 7, discussed Juniors as one of the "three major problems before the Board" [the other two were the Local Sections and the Technical Divisions]. "After a long struggle," said Mr. Ayres, "the Board is about to experiment with new machinery in the interest principally of the Juniors." The "new machinery" set in motion was the Committee on Professional Objectives, "to consist of seven members . . . with willingness to assume leadership in dealing with pioneer problems in the Society." Said Mr. Ayres, "The problem of the Juniors goes to the very core of the present and future objectives of the Society. In the past the Society has been a purely

technical group interested mainly in technical enlightenment and progress . . . Now it appears that a large number of members seem to be less interested in technical discussion and literature than they are in matters affecting their well being and the welfare of the profession." Thus it was with the "social, economic, and political welfare" of its Juniors at heart that the Society took the first, tremendously significant step in the direction of becoming a strong professional as well as technical organization.

Pointing to the need for getting more "corporate members," Mr. Ayres implied that there was no shortage of Juniors. "The activities of the colleges in recent years," he wrote, "have brought an abundance of members in the Student Chapters and considerable numbers of these have gone into the Junior grade. The result has been . . . an increase in Juniors in the past twelve years of from 1,000 to 3,736, or from 9½ percent to nearly 24 percent of the total."

In the June 1940 issue (page 386) Prof. Scott B. Lilly, chairman of the Committee on Juniors, reported the results of a questionnaire survey of all the Society's Juniors to determine their professional attitudes and their interest in developing Junior Forums. He urged the committee not to be too discouraged "if the response of the Juniors is less than 100 percent. Juniors are passing through a difficult period of adjustment. At times it may be hard for them to find the time and the energy for professional development."

It was not until 1947 that Juniors were given any voice in ASCE Convention plans. In that year the Annual Meeting Committee of the Metropolitan Section took action to make the president of the Section's Junior Forum a member of the committee.

What made 1947 a really memorable year in ASCE history, was, of course, the enfranchisement of the Juniors. In balloting that took place on October 7, the Society Constitution was amended to give them full "corporate" status, with all membership privileges including the right to vote and to hold office. As evidence of the interest of the membership in abolishing distinctions between the older and the younger in the Society is the fact that the amendment to enfranchise Juniors was carried by a very considerable margin in the same election in which a proposed dues increase was rejected.

Any remaining suggestion of distinction between the younger and older members of the Society was eliminated in 1959, when the ASCE Constitution was again amended in a move to abolish the grade of Junior Member. On June 6 all Junior Members automatically became Associate Members. There are currently 17,752 in this younger-member group, some 14,000 more than there were in 1930. The group constitutes 31 percent of the present total membership of 44,435.

In an article on "The Young Engineer in ASCE" in the July 1957 issue, Executive Secretary Wisely saw the group as an important "project" of the Society and not as the "problem" sometimes alleged. Said Mr. Wisely, "Basic policies of the Society with regard to its younger members are found to be sound and effective in comparison with other engineering societies. And there is certainly no reason for the young engineer to feel that he is a forgotten man; if anything there may be evidence that he is being exceedingly well remembered!"

To implement his conclusions, Mr. Wisely discussed seven areas of Society action aimed at removing distinctions, false or otherwise, between the older and younger members and assimilating the younger group, with its tremendous strength and potential, as fully as possible into ASCE activities.

With institution of "The Younger Viewpoint" in July 1958, ASCE had the aim of affording younger members a chance to talk to each other in the pages of CIVIL ENGINEERING, to air matters of common concern to young professionals. The very existence of such a forum for younger member opinion emphasizes the fact that younger and older members in ASCE have a common ultimate goal—the advancement of the Society and the profession.

Committee on Younger Member Publications

Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 289 Foxhill Road Denville, N. J.	Albert C. Nelson 250 N.E. 51st Street Miami, Fla.	Walter D. Linzing 4751 No. Paulina Chicago 40, Ill.	Judd Hull 3178 Almeria San Pedro, Calif.

Irvin Schwartz Joins Technical Publications Staff

Irvin J. Schwartz was recently appointed to the headquarters staff of ASCE as Assistant Editor of Technical Publications. Mr. Schwartz received his engineering degree from the University

Irvin Schwartz

of Illinois in June 1958. While there he was an active member of the Student Chapter of ASCE and a staff member of the *Daily Illini*. He had previously (1954) received a degree in liberal arts from Illinois. Since his graduation in 1958 he has been employed as a construction engineer for the Corps of Engineers.

Mr. Schwartz's appointment follows expansion of the ASCE Technical Publications staff authorized by the Board of Direction at its Washington meeting.

New Movie Available To Student Chapters

ASCE has been given one print of a movie that will be of interest to Student Chapter, Local Section, and other educational and civic groups. Entitled "The Fabulous Decade," the film records the dramatic story of new developments in transportation and shipping at the Port of New York during the past decade. It is the gift of the Port of New York Authority.

"The Fabulous Decade" is a 16-mm sound film, photographed in Ektachrome. Running time is 22 minutes. Requests to borrow the film should be sent to ASCE headquarters, 33 West 39th Street, New York 18, N.Y.

Since ASCE films are loaned on a first-come, first-served basis, it is advisable for the Chapters and other groups to make their requests as early as possible.

Pittsburgh Section Has Son And Father Life Members

Pittsburgh Section members will witness an unusual, if not unprecedented, situation at their annual dinner meeting, on January 21, when Robert A. Cummings, Jr., receives his Life Membership Certificate from President Marston. He will be presented to President Marston by his father, Robert A. Cummings, Sr., himself a life member of the Society for many years. Despite his 94 years, the senior Mr. Cummings still attends Section meetings. He is a former Director and Vice President of the Society.

Kansas City Section Host to Construction Conference

What's right? What's wrong? What's new in construction? Over 400 engineers, contractors, and others interested in the construction industry sought answers to these questions at a Mid-Century Construction Conference sponsored by the Kansas City Section, November 12-13. Co-chairmen were Reed McKinley, city manager of Kansas City, and I. E. Taylor, regional engineer for the Bureau of Public Roads at Kansas City.

In a general session dealing with concrete construction, Thomas B. Douglas, vice-president of operations for the Ideal Cement Co., Denver, described new uses of concrete in process plants, with special reference to the use of precast and shell construction in erecting a new plant for the company in New Mexico. Quality control of concrete was discussed by Vice-Admiral John J. Manning, now managing director of the Concrete Industry Board, who called for cooperative action to correct wrongs in the industry. Ben C. Gerwick, Jr., head of the San Francisco construction company bearing his name, spoke on the use of prestressed concrete in western Europe, Russia, and the Middle East.

In a second session, entitled "Down to Earth," discussion ranged from problems involved in the placing of prestressed piling for deep foundation piers located on marshy ground to unusual methods employed in underwater construction. Speakers were John N. Newell, vice-president of the Kansas City Bridge Company; J. M. Clark, vice-president of the List & Clark Construction Company; L. G. Feil, chief of the Engineering Division of the Corps of Engineers at Kansas City; and J. B. Smith, district manager of the Raymond Concrete Pile Company at Kansas City.

In the final session steel was discussed by Lothar E. Berg, executive vice-president of the John F. Beasley Construction Company, Dallas, Tex.; W. G. Rapp, of the Bethlehem Steel Company, Bethlehem, Pa.; and Frederick Dill, of the American Bridge Division of U.S. Steel, Pittsburgh. J. F. Lincoln, chairman of the board of the Lincoln Electric Company, Cleveland, discussed welding standards as viewed by industry. In his opinion industrial advancement is being hampered by unnecessary tests and inspections required.

A scientific rather than political solution to the problems of the world was urged by Dr. A. Allan Bates, vice-president for research and development for the Portland Cement Association and featured Thursday luncheon speaker. Many of the world's present problems are due to advances in science, he said. Col. L. E. Laurion, district engineer for the Corps of Engineers at Kansas City, discussed the problems involved in building missile launching base installations in the midwestern area at the Friday luncheon.

ASCE CONVENTIONS

NEW ORLEANS CONVENTION
New Orleans, La.
Jung Hotel
March 7-11, 1960

RENO CONVENTION
Reno, Nev.
June 20-24, 1960

ANNUAL CONVENTION
Boston, Mass.
Hotel Statler
October 10-14, 1960

TECHNICAL DIVISION MEETINGS

RESEARCH CONFERENCE ON SHEAR STRENGTH OF COHESIVE SOILS
Boulder, Colo.
University of Colorado
June 13-17, 1960
Sponsored by
Soil Mechanics and Foundation Division

HYDRAULICS CONFERENCE
Seattle, Wash.
University of Washington
August 17-19, 1960
Sponsored by
Hydraulics Division

CONFERENCE ON ELECTRONIC COMPUTATION
Pittsburgh, Pa.
Hilton Hotel
September 8-9, 1960
Sponsored by
Structural Division

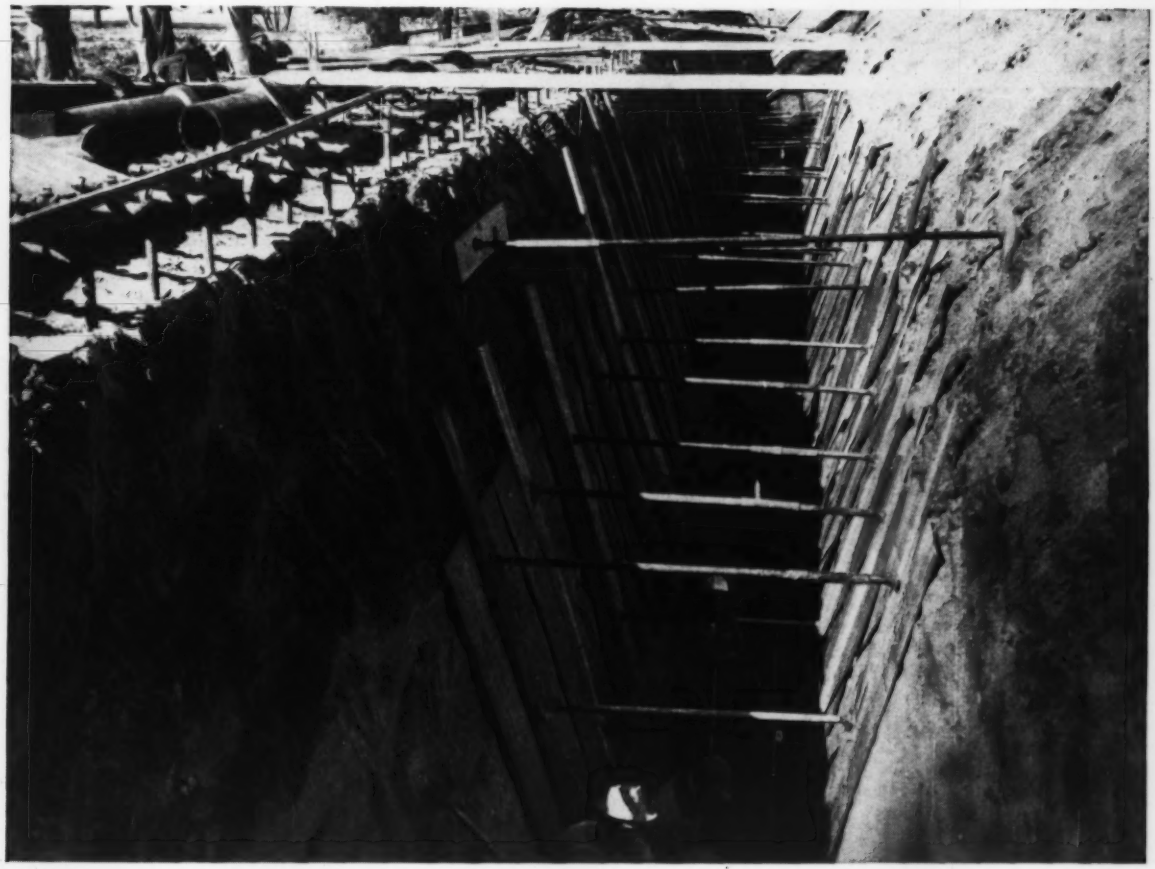
NUCLEAR CONGRESS

New York, N.Y.
Coliseum
April 3-8, 1960
Program Manager
ASCE

Co-chairmen of Mid-Century Construction Conference are seen in left-hand view. They are Reed McKinley (left) and I. E. Taylor. Right-hand photo shows Vice-Admiral John J. Manning addressing group on quality control of concrete. With him is Thomas B. Douglas, who spoke on new uses of concrete in process plants.

HOW TO HANDLE WET JOBS

Project: Sanitary Sewers, El Paso, Texas
Contractor: T. N. O'Kelley, Utility Contractors, El Paso, Texas
Owners & Engineers: Public Service Board, El Paso, Texas



Wellpoints on 1 side perform unusual feat in coarse sand . . .

Dry 18-ft Deep Trench at 3,700-ft Elevation

At the reduced atmospheric pressure of 2/3-mile above sea level, any pump works at a handicap. To compound this problem, the contractor desired to install his wellpoint system (Griffin system) at ground level. Previous wellpoint practice in the area was to place the system on a berm nearer subgrade because of pump lift limitations.

Question: in coarse water-bearing sand near the Rio Grande River, with discharge lines as long as 700 ft at times, could the necessary 18 ft lift be attained by a wellpoint system installed on only one side?

• Based on previous local experience it did not seem feasible, but events proved otherwise. Dry conditions were successfully maintained from the start, enabling T. N. O'Kelley to beat his 100-day time limit by 40 days.

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25th YEAR

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

LOCAL SECTION MEETINGS

Cleveland—Annual meeting on Friday, January 15. Further information may be had by contacting the Section Vice President, Trygve W. Hoff.

Illinois—Weekly luncheon meetings at the Engineers' Club, Chicago, every Friday, at 12 noon.

Intermountain—Regular monthly meeting on the fourth Friday of each month; Ladies'. Night is January 22. A dinner-dance is planned.

Los Angeles—Dinner meeting at the Statler Hotel, Los Angeles, on January 13, at 6:00 p.m.; dinner meeting of the Soil Mechanics Group at the Engineers Club in the Biltmore Hotel on January 20, at 6:30 p.m.; dinner meeting of the Sanitary Group at the Engineers Club in the Biltmore Hotel on January 27, at 6:30 p.m.; social hour and dinner meeting of the Pipeline Group at the Engineers Club in the Biltmore Hotel on January 26, at 6:30 p.m.; reception and dinner meeting of the Transportation Group at the Engineers Club in the Biltmore Hotel on January 28, at 6:30 p.m.; and social hour and dinner meeting of the Santa Barbara-Ventura Counties Group at the El Presidio Restaurant, Santa Barbara on January 19, at 6:30 p.m.

Metropolitan—Regular monthly meeting in the Engineering Societies Building on January 20, at 7:00 p.m.

Oregon—Annual meeting in Portland on January 15.

Philadelphia—Regular monthly meeting of the Younger Member Forum at the Engineers' Club on January 26, at 7:30 p.m.; and regular monthly meeting of the Construction Division at the Engineers' Club on January 21, at 7:30 p.m.

Pittsburgh—Annual dinner meeting on January 21. Contact Robert C. Mathes, secretary-treasurer, for additional information.

Sacramento—Thirty-eighth annual meeting on January 12 and the annual installation of officers and dinner dance on January 16 at the Sacramento Inn. Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon.

Texas—Spring meeting in Midland, Tex., April 21-23.

Under discussion at the afternoon session of the **Iowa Section's** 41st annual meeting were the activities of the Student Chapters at the two state engineering schools. Dean W. Johnson of the State University of Iowa and Dwight Rice of Iowa State University, president of the respective Student Chapters, headed the discussion. The Section's 1960 officers, introduced during the session, are Harris F. Seidel, president; Vernal R. Bennion, vice president; Harold J. Jobse, director (two years); and Rupert E. Kenyon, associate director (one year). Outgoing president Joseph E. Borg introduced the guest speakers—William A. Milek, Jr., who spoke on the plastic design of steel structures, and John R. Shay, who described the Federal grant program for sewage treatment plants. At the dinner session Life Membership Certificates were presented to Keith B. Merrill, Mark B. Morris, and Francis M. Dawson.

At a recent meeting of the **Lehigh Valley Section** Dr. Lynn S. Beedle, research professor at Fritz Laboratory, Lehigh University, outlined the basic concept of the plastic design of steel structures as that "margin of safety inherent in the plastic deformation of steel which can be utilized for an improved design." This reserve ductility provides the 16 to 20 percent saving in steel over the conventional elastic method of design. The membership passed a resolution affirming its continued support of the New Jersey Society of Professional Engineers in the McCamy case (December issue, page 78).

Those present at the November 11 meeting of the **Maryland Section** heard a talk by Dr. Franklin G. Myers, manager of the Reactor Systems Department in the Nuclear Division of the Martin Company, on the practical applications and future possibilities of nuclear systems. Mr. Myers supervises all work for the U. S. Atomic Energy Commission on the development of the new liquid fluidized bed reactor as well as investigations of larger reactor systems to produce process steam for industrial purposes, and of advanced reactor concepts for space-ground based applications. The use of slides simplified presentation of the otherwise complex material.

A first-hand report from behind the Iron Curtain was delivered by W. J. Turnbull, chief of the Soils Division of the Waterways Experiment Station at Vicksburg before a recent joint meeting of the **Vicksburg Branch** of the **Mid-South Section,** the Vicksburg Post of the Society of American Military Engineers, and the Vicksburg Engineers Club. Mr. Turnbull, a member of an exchange delegation of soil scientists, told his colleagues of trusts, private enterprise and other aspects of Russian society. He pointed out that highway construction is lagging and by our standards airport runways are inadequate for commercial jets because of the use of dry concrete and heavy concentration on missile projects, heavy industry and housing development.

Featured speaker at a recent **Nashville Section** gathering was County Judge Beverly Briley, who outlined some of the problems counties will encounter in the Interstate Highway program, such as the acquisition of rights-of-way property and school district and re-districting problems. Earlier in the evening officers for the coming year were elected. John Dennison is the new president; Cecil De Vilbiss, vice president, and Bob Whitaker, secretary-treasurer.

Design and construction of the Fort Pitt Bridge in Pittsburgh was the subject of a recent meeting of the **Philadelphia Section.** George S. Richardson, whose firm designed the structure, presented a comprehensive story of the great Pittsburgh Golden Triangle redevelopment, of which the Fort Pitt Bridge, together with the Fort Duquesne Bridge and the Fort Pitt Tunnel form the final link in the connection between the eastern and western sections of the Penn Lincoln Parkway. The problem of an interchange between the highway network and urban transit traffic, complicated by constricted space, was ingeniously solved by double-deck bridges for one-way on and off traffic.

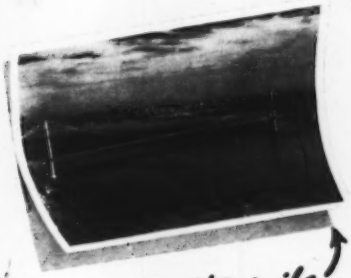
During a meeting of the Construction Division of the **San Francisco Section,** the incumbent officers were re-elected. Serving again in 1960 will be Joe Kaplan, chairman; Ed Schulhauser, vice chairman; and Dick Lowell, secretary-treasurer. Featured speaker was Francis J. Murphy, youthful vice president and general manager of Yuba Consolidated Erectors, Inc., who entertained those present with stories of his experiences in heavy construction. The Division reports the close of a very successful year, in which attendance at meetings quadrupled.

measure Roebling's "Bridge-Ability"

Shown here is the new Kishwaukee River Bridge at Seth B. Atwood Park, New Milford, Illinois. It was designed, furnished and erected by the Wisconsin Bridge & Iron Company, Milwaukee, Wisconsin. Its main cables are Roebling 1⅛" prestretched, galvanized bridge strand.

This structure is an excellent example of the scope of Roebling's Bridge Division activities, whether it be large or small—design, erection or, as in this instance, supplying the cables.

Doubtless, you don't have a "Golden Gate" to bridge at the moment. You may, though, have a pedestrian handling problem in your plant, a materials-handling problem *anywhere*. It is important to remember that Roebling's familiarity and experience with suspension systems of *any* description puts us in the unique position of being fully able to help you solve problems along these lines. We welcome inquiries touching on any phase of suspension by wire rope or strand. Just ask Roebling's Bridge Division, Trenton 2, New Jersey.



by the mile
(Golden Gate Bridge)

by the foot
(Kishwaukee Bridge)

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Discussion follows a timely talk on ASCE affairs given by ASCE Vice President Lloyd D. Knapp (second from right) at the November meeting of the Kentucky Section. Seen, in usual order, are David K. Blythe, secretary-treasurer of the Kentucky Section; David H. Sawyer, president; Mr. Knapp; and Daniel V. Terrell, Past-President of ASCE.

Past presidents of the Indiana Section were honored with certificates of service at a recent Section meeting. The line-up included (ascending the stairs at the left) J. Russell Cooper, president in 1959; Ralph E. Simpson, 1943; Joseph I. Perrey, 1958; Frank W. Stubbs, Jr., 1957; William E. Harrison, 1955; and Ben H. Petty, 1942. To the right are Don E. Bloodgood, 1950; Carl E. Vogelgesang, 1948; Ralph B. Wiley, 1946; Don M. Corbett, 1951; James T. Hallett, 1945; and Joseph H. Hnot, Jr., 1959 vice president. The Section has eleven other past-presidents who were unable to attend the meeting.

Participating in a panel discussion on military construction in the Pacific area at a recent meeting of the Hawaii Section are (left to right) Brig. Gen. Ellsworth I. Davis, Pacific Ocean Division Engineer, who acted as moderator; Col. Menon. W. Whitsitt, Okinawa District Engineer; Edward J. Morgan, Hawaii Section president; Col. Daniel A. Richards, Far East (Korea) District Engineer; and Col. John R. Clifton, Honolulu District Engineer. Each district engineer discussed unusual engineering problems arising in his area.

The largest turnout in many a year attended the **Tennessee Valley Section's** recent **Asheville Branch** meeting. After dinner the group joined the Engineers Club of Western North Carolina to hear Captain James R. Butterworth of the Redstone Arsenal at Huntsville, Ala., talk on engineering for the space age . . . A talk on airport traffic control was given by Harry P. Brady, chief airways operation specialist at Lovell Field, Chattanooga, at a recent meeting of the **Chattanooga Branch** of the Tennessee Valley Section. Mr. Brady traced the progress which has been made over the past thirty years.

New officers of the **Dallas Branch** of the **Texas Section** are Llewelyn Powell, president; Lee Halford, vice president and James W. Porter, secretary-treasurer. Senior director is Allen Hundley, associate director, J. B. Templeton, Jr., while Dwight Morgan is state director . . . Seventy-five members and guests of the **Houston Branch** recently heard Mason Lockwood on why he thought the United Engineering Center should be in New York City. Mr. Lockwood then discussed important projects of the Houston Chamber of Commerce and their influence on the future development of Houston. Projects covered by the speaker were the Trinity River Development, direct airline service to Florida and California, and urban renewal planning.

Douglas B. Fugate, assistant chief engineer, Virginia Department of Highways, was elected president of the **Virginia Section** at the Section's December 4 meeting. Other new officers are Henry P. Sadler, vice president; Prof. D. H. Pletta, and Prof. H. L. Kinnier, directors-at-large. Frank G. Louthan, Jr., was reelected secretary, and J. E. Watlington, Jr., treasurer. John E. Krome and Col. James M. Morgan, Jr., are also Section vice presidents.

D. B. Fugate

"The History of the Milwaukee Housing Authority" was discussed by Charles Vogel, acting head of development for the Authority, at a recent meeting of the **Wisconsin Section.** He stated that the 1949 Housing Act, a supplement to private housing, provides for direct governmental assistance to local housing authorities in those instances where private housing does not meet local needs. A 120-unit Convent Hill project and a 382-unit Lapham Park project is presently planned by the city.

Some Ideas

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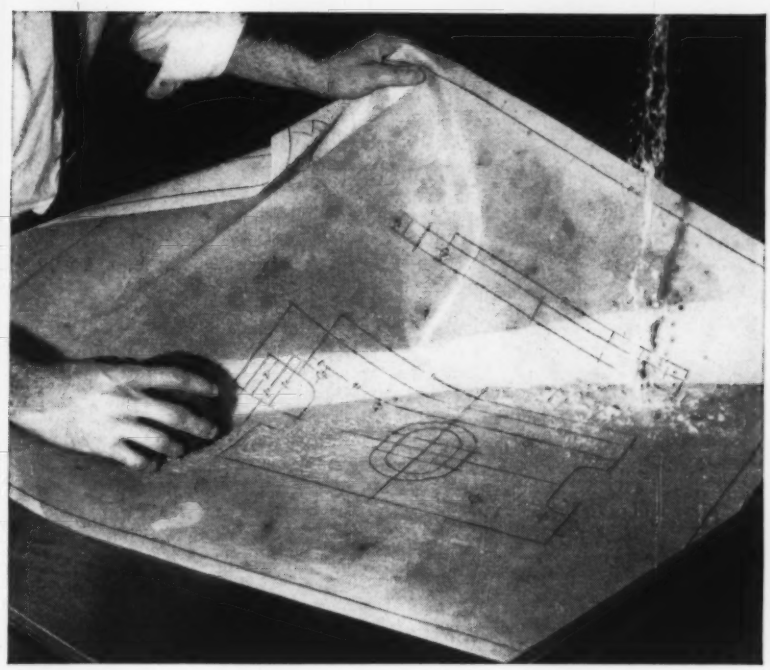


This badly-soiled drawing is getting a mild soap-and-water bath to restore its original printing quality.

Tracings you can wash! Mention this to a Chief Draftsman and you'd likely see his eyes light up as he perceives the implications of a simple new technique – one that's being used now by Raytheon Co. and could save them at least $50,000 this year. The secret: Herculene® Drafting Film by K&E, plus Staedtler Duralar plastic pencils –a completely washable combination, and the answer to . . .

A Dirty Old Problem

Functionally, an engineering drawing is only as good as the prints it will produce. This is a fact of life that governs any distribution-print system – conventional blueprints, white prints, or reduced-size prints. It holds true in a full-fledged miniaturization program, too. How long will an original tracing continue to produce top-notch prints? The answer depends on how much and what kind of handling it receives. Revisions, smudging, processing and filing all take their toll of a drawing's printability, decreasing it gradually – and sometimes quite sharply. As printing quality diminishes, some form of rehabilitation becomes necessary. But re-drawing – whether manual or photographic – can be costly and time-consuming. Drafting and reproduction experts have been wishing and working for a more efficient and economical solution.

A Simple Solution: Soap-and-Water

Washing became a possible answer with the advent of polyester-base drafting films and plastic pencils – and a practical reality with Herculene. This remarkable film combines a stable, waterproof Mylar® base with a completely washable surface for smudge-proof Duralar pencil lines – which *bond* to the Herculene surface and won't wash off.

Only the dirt washes away. There's no loss of line-background contrast, no loss of detail. The tracing can be restored to its original condition in a few moments – without re-drawing!

A Proved Money-Saver

To amplify an earlier point: the Missile Systems Division of Raytheon has been washing Herculene drawings for the past year, and now expects to save over $50,000 on re-draws alone in the year ahead. A large aircraft manufacturer has used the Herculene-Duralar soap-and-water method even longer, and reports impressive dollar savings plus an outstanding improvement in print quality.

In 6 months of testing and 14 months of actual drafting-room use, Raytheon engineers exposed Herculene to all basic trials – and a battery of fiendishly extreme conditions. They scored Herculene with a sharp scriber, but couldn't remove the matte surface. They taped a sheet to the floor and had a 200 pounder roll over it in a swivel chair during an active day. Herculene was baked and frozen – and doused with hot coffee – with no effect on its surface. After two hours, the coffee stain was washed off without a trace. Results of these torturous tests were so favorable that now, Raytheon's Missile Systems Division uses practically no drafting film *but* Herculene!

A Note of Caution

There are other waterproof drafting films, but plastic pencil lines will wash off some of them. So, when comparing polyester-base films, it's best to check them for *pencil line washability*. And another point – don't try this technique with ink or graphite lines – use only the Duralar K1 or K2. Even if you don't want to adopt the washing technique immediately, you're free to make the change at any time if you use Herculene – the *indestructible* drafting medium with the washable, engineered surface.

More Merciless Testing Invited

We'd be pleased to send you a sample of Herculene, and we invite you to do your best to ruin its excellent drafting and printing quality. The Herculene sheet comes in a small folder with complete instructions and a water-fast Duralar pencil – which K&E engineers helped develop for use with washable Herculene Drafting Film. Mail the coupon below for your sample!

KEUFFEL & ESSER CO., Dept. CE-1, Hoboken, N. J.

Please send me further information about the washable tracing method, plus a sample sheet of Herculene Drafting Film and a Duralar pencil.

Name & Title_____

Company & Address_____

_____ 1809

BY-LINE WASHINGTON . . . . .

The political battles that will occupy the **present session of Congress** will find construction holding center stage in most areas. Public works appropriations, housing and urban renewal, military construction, increased grants for pollution control will be the principal battleground in what will undoubtedly be a short session (ending before mid-July at latest) in deference to the political fact that not only control of Congress but the Presidency will be at stake in 1960.

Other bills of major importance due for an airing, at least, as Congress gets down to business will probably include some serious proposals for changing the criteria on which Bureau of Reclamation projects are judged (to include recreation, pollution control, etc.); a move for some changes in the Davis-Bacon and Walsh-Healy acts (which dictate rates of pay on construction projects, among others); a number of measures designed to give highway interests an equal voice in determining highway bridge clearances and heights over navigable streams; some attempt by the Administration to get additional gasoline taxes to finance the Interstate Highway program more fully; a series of proposals for putting government transportation activities and water activities under single departments or agencies.

You can assess the chances of this legislation rather correctly: The only one that seems to have a really good chance of passage is the proposal for changes in the Reclamation criteria. The pollution-control bill (raising grants to around $100 million a year) will be passed—and almost certainly vetoed. Another bill is a toss-up. This is the possibility that the Administration may relax its strictures on "new starts" in public works—a move that would be completely out of character, on past performances, but within the possibilities of a political year.

* * *

It is also certain that the **House Ways and Means Committee** will produce some kind of legislation looking to **tax reforms**—and possibly at the hoped-for objective of a tax reduction. It is anybody's guess on Capitol Hill as to what form these reforms might take. But only one thing is certain—they will not take the tax exemption away from state and local bonds, as has been advocated before the committee by a number of witnesses. Though the government has been told it could capture as much as $2 billion in new taxes by such a move, the immediate and unanimous opposition of local government officials, bond experts, and the construction industry, would seem to make it impossible.

* * *

There will be one piece of **highway legislation** up early—and there seems to be no doubt about this one: the biennial allocation for the "ABC" (primary, urban and rural) roads. The only question is whether Congress will follow its two-year-old pattern of raising the ABC ante by $25 million yearly (it's now running at $875 million). Since the ABC money also comes out of the depleted Highway Trust Fund, there is some doubt that added money will be approved.

Members and officers of "scientific" organizations would do well to get a copy of proposed regulations by the **Internal Revenue Service** concerning tax-exempt status of such organizations (printed in the Federal Register for December 1). Meat of the regulation is that the research conducted must be available to the general public, must not be used only to further the objectives of the organization.

* * *

Continuing its efforts to put itself on a par with competitive private engineering organizations, the U.S. Government has just announced a number of increases in entrance pay rates for Grades GS 5 through 14 for community and regional planners, and for oceanographers in Grades GS 9, 11 and 12. The raises average about $500.

* * *

Progressive expansion of highway systems, parking areas, and other municipal services are posing a serious threat to **city parks and open areas.** That's the real fear of Harry T. Thompson, Superintendent of National Capital Parks, who says he has seen the city's park areas progressively nibbled away. He blames "too easy" acquiescence of park officials and the fact that much park land seems to be easily obtainable without the cost of condemnation and battles with property owners. It has been proposed that a highway department donate equal land, in exchange for park lands it takes. This, according to Mr. Thompson, might make park land so expensive that condemnation of built-up property would be a simpler answer.

* * *

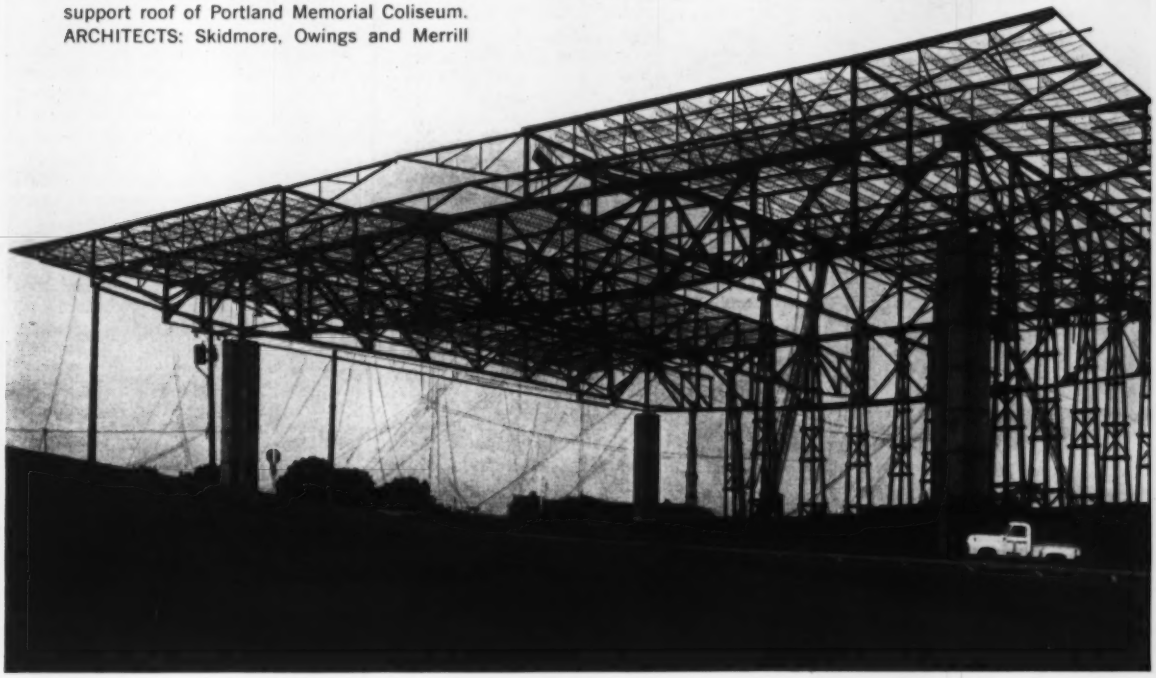
Experiments in evaporation control, carried out on a rather small scale at an Oklahoma City reservoir over the past two years, will be extended this year to large reservoirs in the arid West. The Bureau of Reclamation has picked Lake Mead and Lake Sahuaro (behind Stewart Mountain Dam near Phoenix) as sites for its experiments. Lake areas will be "dusted" (from airplanes) with a mixture of hexadecanol and octodecanol—vegetable derivatives—to see if the film thus formed will appreciably cut evaporation losses. The previous experiments were considered successful, in that they prevented at least 10 percent of normal evaporation from the Oklahoma reservoir, despite admittedly crude distribution systems, and bad weather conditions.

* * *

Despite misleading headlines in local newspapers, **the General Services Administration maintains no "blacklist"** of contractors—and has no intention of establishing one. What GSA has done (and what gave rise to the stories) was to insert a clause into all contracts, requiring prime and subcontractors to agree to testify before courts and other proper bodies (including Congressional committees) on matters pertaining to the present, or previous government contracts. The action was the result of a complaint by the McClellan Committee that a St. Louis bricklaying subcontractor, who had "taken the fifth" before the committee, now holds two subcontracts on St. Louis federal work.

QUALITY-ECONOMY COMBINED

130,000 square feet of Macomber ALLSPANS support roof of Portland Memorial Coliseum. ARCHITECTS: Skidmore, Owings and Merrill



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NEWS BRIEFS . . .

Geological Survey Opens California Mapping Center

A new mapping center for the U. S. Geological Survey was dedicated by Interior Secretary Fred A. Seaton at Menlo Park, Calif., on November 24. The project which cost $1,350,000 provides a modern center for topographic mapping work in eight Western states. Started in July 1958, the new facility will replace the Survey's former headquarters at Sacramento.

The Menlo Park center is equipped to produce 40 new or revised topographic maps each month. It takes about three years to complete each map, and approximately 1,500 Pacific area map manuscripts are in process at all times. Maps produced in the Survey centers become quadrangle sheets of the National Topographic Atlas. About 45 percent of the country is now covered.

The Geographical Survey's other regional topographic mapping centers are located at Denver, Colo., Rolla, Mo., and Arlington, Va.

Chicago to Spend $45 Million For Water Works in 1960

In 1960 Chicago will spend $45 million for construction of water works, the heaviest expenditure of any single year in the city's history. The appropriation includes $27.9 million for filtration plants, $8.5 million for pumping stations and tunnels, and $8.6 million for water mains. According to Water Commissioner James W. Jardine, "The improvements reflect a national trend among water utilities to increase capacity in anticipation of future demand."

This will be the second year of Chicago's current five-year $128.3 million program designed to assure plentiful supplies of filtered water for Chicago and 58 of its suburbs. Most of the current appropriation for filtration plants will be used to further work on the Central District Plant now under construction on the lakefront near Navy Pier. The $100 million filtration plant will be the largest of its kind in the world. It will have a daily capacity of 1.7 billion gallons and will serve over 3,000,000 people.

The city's five-year water-works program is a significant part of its overall $751 million program for public works. The program includes $71.3 million for sewer construction.

Roundup of Scholarships

Civil engineers wanting to do graduate study will be interested in a survey of graduate scholarships, fellowships, and assistantships available to civil engineering students in 1960, which has been prepared by Chi Epsilon, national civil engineering honor fraternity. Copies of the detailed roundup of opportunities for advanced study have been sent to the civil engineering departments of all U. S. (and some foreign) colleges and universities. The survey covers over 500 individual awards with total value of more than $1,000,000.

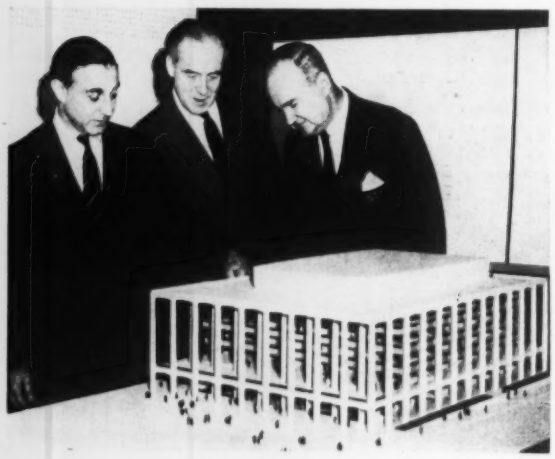
Single copies of the survey are available as long as the supply lasts. Request should be made to Michael A. Spronck Member, Supreme Council, Chi Epsilon Fraternity, Martinsville, N. J.

Bids Opened for Narrows Bridge Piers

J. Rich Steers Inc. and the Frederick Snare Corp., as coventurers, were apparent low bidders on both tower piers of the Verrazano-Narrows Bridge, when bids were opened on December 16. Their bid of $16,527,975 compares with $17,962,690 for a Raymond-Dravo combination; $18,312,090 by the Merritt-Chapman & Scott Corp.; $20,608,627 by the Felhaber Corp.; and $21,569,362 by Johnson Drake and Piper. All are New York City firms except Dravo, which is Pittsburgh based.

Steers-Snare, who have just installed a deep caisson for one anchorage of the Throgs Neck Bridge in New York, were low bidder on each of the piers separately as well as on the two combined. An alternate for use of Drilled-in-Caissons, rather than going full depth with open caissons for the Brooklyn pier, was bid only by the Felhaber Corp.

The Verrazano-Narrows Bridge, connecting Brooklyn and Staten Island at the entrance to New York Harbor, is a joint project of the Port of New York Authority and the Triborough Bridge and Tunnel Authority. Completion of the project, which will include the world's longest suspension span, is scheduled for mid-1964.



Design Completed for Lincoln Center Music Hall

Scale model of final design of Philharmonic Hall, the first building to be constructed in New York City's Lincoln Center for the Performing Arts, is shown to Reginald Allen, executive director for operation of the center, and David Keiser, president of the New York Philharmonic. At left is Max Abramovitz, F. ASCE, of Harrison & Abramovitz, architects for the project. The hall is designed to give the effect of a series of shallow terraces surrounding the main orchestra level and flowing into the stage itself without proscenium divisions to interfere with sound effects. Though the hall will seat 2,400, no seat will be farther from the stage than 138 ft. The highest seat will be 45 ft above the stage (at Carnegie it is 74 ft).

Malpasset Dam on French Riviera Fails

Malpasset Dam, a 200-ft-high structure on the Riviera in Southern France, failed completely on December 2. Water sweeping down the valley 7 miles to the Mediterranean destroyed everything in its path and caused about 300 deaths. The structure, built in 1952-1954 for irrigation and water supply, was the thinnest arch dam of its height constructed up to that time, having maximum thickness of 22 ft 8 in.

The dam, on a 344-ft radius, filled about 135 deg of arc in an area between two high rock abutments. It stored 22 million cubic meters (17,800 acre-ft) of water in a lake six miles long. There had been steady rain for several days, and it is probable that an additional 4,700-acre ft of storage available for flood control was in full use at the time of the failure. The spillway was a 96-ft section of the dam designed to permit overflow and discharge well clear of the foot of the almost vertical structure. Overflow was designed for a maximum of 250 cubic meters per second (about 9,000 cfs) with water falling on a heavily reinforced 20-in.-thick concrete apron. Early reports from the area do not indicate that the falling water or undermining of the structure contributed to the failure.

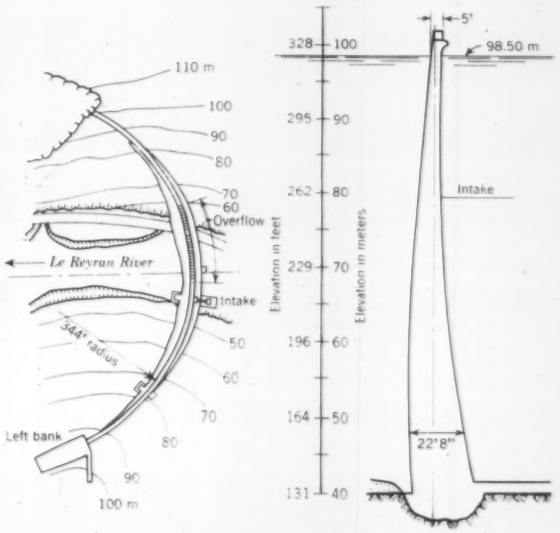
Information on the existing dam comes from the English edition of a booklet distributed at the Fifth International Congress on Large Dams, 1955, which was prepared by the French technical magazine, *Travaux*. The following is quoted directly from that publication: "The dam is essentially a thin arch with radii which vary with the height, both on the downstream and upstream sides, which allows at the cost of a slight complication of the forming for a better utilization of material. On the right bank, the arch rests on a massive rocky peak. On the left bank it rests on an abutment protected by a wing wall which was found to be necessary by the topography of the site."

Construction started in April 1952. Summer flow in the river was so small that work could be carried on with water diverted through a 40-in.-dia concrete conduit. Excavation extended about 20 ft down into the river bed. Concrete was poured in monoliths about 44 ft long and 5 ft high with concreting of adjacent sections always being spaced out by about 3 lifts. The joint between the rock and the concrete was made by the injection of a cement grout through drill holes. A total of 62,000 cu yd of concrete was placed over a period of 30 months, with a maximum rate of about 390 cu yd per day.

Malpasset Dam was constructed by the Department of Var with the technical assistance of the French consulting firm of Coyne & Bellier. Construction was done by the Entreprises Léon Ballot and Gianotti Frères. The cost was 580 million French francs, about $1.5 million at the rate of exchange at that time.

An engineering investigating committee has been appointed, but it is not expected that it will have even a preliminary report for several weeks. A study of available photographs and meager information available from France indicates that failure of the rock at one abutment may have initiated the movements of the dam that permitted its collapse. At the time of its construction Malpasset Dam was widely hailed as the thinnest structure for the pressures involved yet constructed. This ratio has since been exceeded considerably by the same designers. The thinness of the structure does not appear to have been a contributing cause to the failure, so far as is known.

Failure of Malpasset Dam recalls the destruction of St. Francis Dam at Saugus, Calif., March 12, 1928, under quite similar circumstances. St. Francis was a gravity arch structure with a height of 175 ft above stream bed and 30 ft below. It had been completed two years before, and the 38,000 acre ft reservoir had just filled for the first time. The dam cost $1.5 million. Faulty foundation material, which permitted movement after water had been forced into the rock by pressure from the reservoir, is said to have caused the failure. There were 426 fatalities.



Malpasset Dam was thinnest arch structure of its type at the time it was completed in 1954, having maximum thickness of 22 ft 8 in.

Very little was left of the concrete arch of Malpasset Dam after nearly 2,000 acre-ft of water with an initial 200-ft head swept over it. The dam filled about 135 deg of arc in an area between two high rock abutments.

Sludge Gas Powers Eight-Turbine Sewage Works

New sewage treatment installation now in operation in Britain produces its own power. All the power and heat needed are provided by eight gas turbines, which use as fuel sludge gas produced during treatment of the sewage. The plant, operated by the London County Council at Becton, Essex, has a capacity of up to 200 mg and services a 112-sq-mile area of Greater London with a population of nearly 3,000,000. In the activated sludge plant shown here, the sludge is reaerated by air blowing for about 16 hours in reaeration channels. In the six aeration sets, the activated sludge and sediment sewage are mixed and circulated by means of paddles in double compartment channels before being passed to a final settling tank. Cost of the project was $25,650,000.

Building Costs Rise In Six-Month Period

Construction costs in the United States (exclusive of Alaska and Hawaii) rose 2 percent in the six-month period between March and September, according to Myron L. Matthews, manager-editor of the Dow Building Cost Calculator, an F. W. Dodge Corporation service. The 2 percent increase is an average figure based on building material prices and hourly wage data received from 144 metropolitan areas in all parts of the country.

Commenting on the construction cost rises, Mr. Matthews stated: "Costs for erecting buildings now average about 2.57 times what they did in 1941. Generally, it takes $2.57 to buy and assemble as many sticks and bricks and as much concrete and steel as $1.00 did 18 years ago. This means that the 1941 building dollar has shrunk an average of 3.4 cents in purchasing power annually until now 61 of the original 100 cents have faded away." Put another way, each dollar invested in a building in 1941 has grown to a value of $2.57, minus depreciation of at least 20 percent. This leaves $2.06, a gain of $1.06 on each dollar, or a little less than an annual average of 6 percent.

Of the two major components measured (materials and labor at the site of construction), labor has again exhibited the greater strength. In the six months ending October 1, building material prices to builders in contractors' quantities did not change in 72 of the 144 reporting areas. Slight decreases were reported in 22 areas, and in 50 areas prices rose modestly. By contrast, labor costs rose in 129 areas, decreased slightly in five weakly organized areas and remained unchanged in ten others.

Engineering Firm Changes Its Name

Beginning this January, the New York engineering firm of Parsons, Brinckerhoff, Hall & Macdonald is changing its name to Parsons, Brinckerhoff, Quade & Douglas, in order to incorporate in its title the names of two partners senior in service. There are six active partners: Maurice N. Quade, Walter S. Douglas, Alfred Hedefine, John O. Bickel, Rush F. Ziegenfelder, all Fellows ASCE, and William H. Bruce, Jr., M. ASCE.

The firm, founded in 1885 by William Barclay Parsons, enters its seventy-fifth year of engineering practice this year. Among its many widely known projects are the Garden State Parkway in New Jersey, the Hampton Roads Bridge-Tunnel Project in Virginia, and the Sunshine Skyway in Florida. Its current projects include the second Elizabeth River Tunnel in Virginia, water supply for Newark and Akron, and sewerage systems for Binghamton and Baton Rouge.

Ten-Year Index to Sewage And Industrial Wastes

Engineers concerned with waste-water technology will be interested in a new Ten-Year Index to *Sewage and Industrial Wastes*, just issued by the Federation of Sewage and Industrial Wastes Associations. This Index for the decade ending December 1958 continues the Federation's indexing practice initiated in 1948 with publication of a Twenty-Year Index to *Sewage Works Journal*, the predecessor to the Federation's present journal.

The new Index provides the key to the wealth of specialized information on waste-water collection and treatment, which has appeared in the monthly publication. The 10,000 entries cover all original contributions and pertinent notices, plus subject and geographical indexes for abstracts published over the ten-year period.

The Index sells for $4.00 in maroon buckram binding and $3.00 in heavy paper. Orders should be sent to the Federation of Sewage and Industrial Wastes Associations, 4435 Wisconsin Avenue, Washington 16, D. C. Postage will be prepaid when a check accompanies the order. If an invoice is required, postage will be added.

Program Seeks Better Steel for Nuclear Reactors

A joint program to develop improved steels for use in nuclear power reactors is being carried out by the General Electric Company and the United States Steel Corporation. It is expected that the testing and development program will provide superior steels, which will help reduce both capital and operating costs of nuclear power plants. The program constitutes the first large-scale investigation of radiation effects on steels carried on in a private test reactor and wholly financed by private industry.

In one phase of the program the corrosion resistance of a wide variety of steels is being carefully investigated under conditions simulating those in actual boiling-water reactor service. Specimens are being exposed to hot water and steam in high-pressure autoclaves and in corrosion test loops at General Electric's San Jose facilities. The steels that best withstand this preliminary screening will then be exposed to actual conditions of corrosion and radiation in the company's test reactor at Pleasanton, Calif.

Summer Institutes Sponsored by NSF

Financial aid will be available in 1960 for about 18,000 high school and college teachers of science, mathematics, and engineering to participate in Summer Institutes sponsored by the National Science Foundation. Grants totaling more than $21,000,000 will support 379 Institutes next summer in 265 educational institutions. The number of teachers accommodated in each of the Institutes will vary from 15 to over 100, and the Institutes will vary in length from four to twelve weeks. Tuition and fees will be paid for the teachers attending. They will also receive stipends of $75 a week, plus allowances for travel and dependents.

Participants will be chosen by the Institutes themselves and *not* by the National Science Foundation. Hence applications for participation must be addressed to directors of the individual Institutes. A list of Institute directors and the host institutions may be obtained from the National Science Foundation, 1951 Constitution Avenue, N.W., Washington 25, D.C.

The success of previous Summer Institutes in meeting the needs of teachers has been responsible for the rapid expansion of the program, which started in 1953 with an experimental two Institutes. There were 125 Institutes in 1958 and 350 in 1959.

Major Airport Planned for N.Y.C. Metropolitan Area

A site in Morris County in northern New Jersey has been recommended by the Port of New York Authority as best for the major new airport that will be needed to serve the needs of the metropolitan New York-New Jersey area. The Port Authority reported to New Jersey's Governor Meyner after three years of peliminary studies of the need for and location of an additional airport.

The report noted that by 1975 airports in the metropolitan area will be faced with air passenger traffic 3½ times the current flow, and the increase in cargo traffic for the same period is expected to be four-fold. Even with the completion of all improvements underway at New York International, LaGuardia, and the continuing program at Newark, additional facilities will be urgently needed.

Calling the proposed Morris County site the only potential site in the area to meet all the requirements for the proposed airport, the preliminary report stated that arriving and departing aircraft, when beyond the boundaries of the 10,000-acre airport, would be high enough not to inflict excessive noise on the airport neighbors.

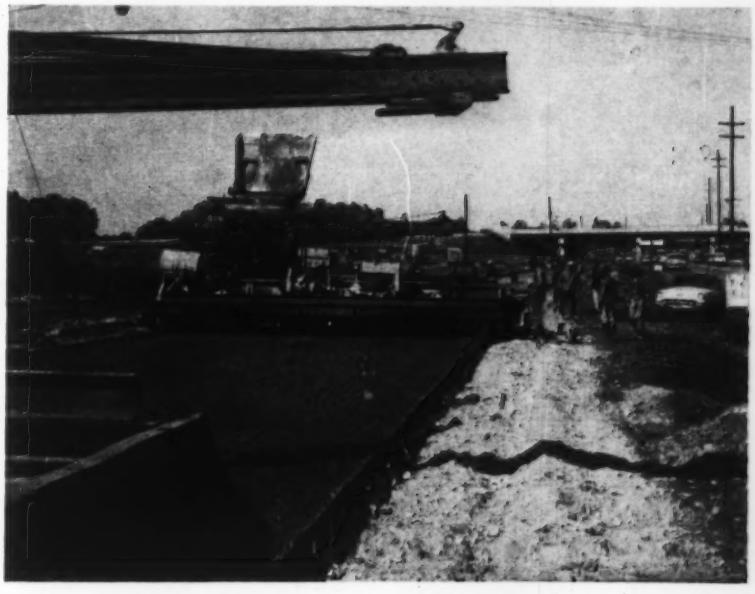
Approval by both the New York and New Jersey legislatures will be required before the estimated $220,000,000 project can be built.

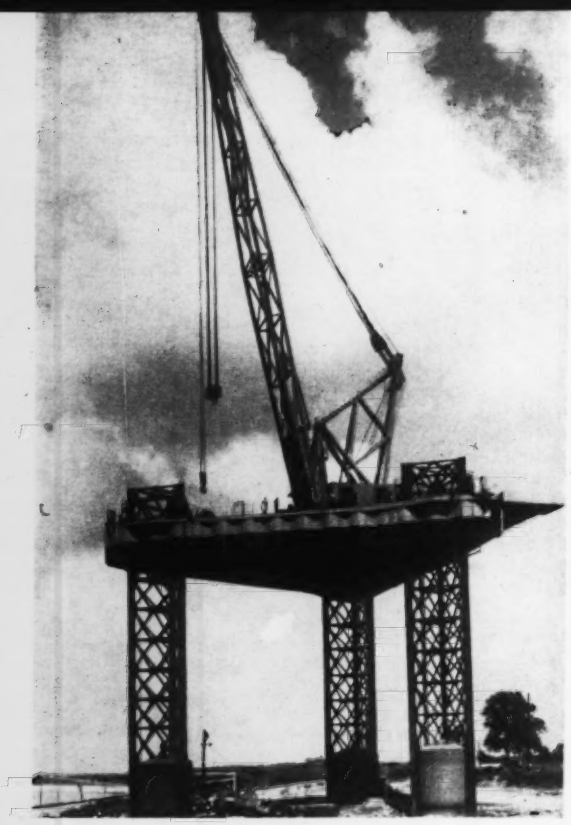
Spillway Gate for Priest Rapids Dam

This is one of twenty-two 90-ton spillway gates installed in Priest Rapids Dam for controlling pool level. Innovations in the mammoth gates, designed and fabricated by the Yuba Manufacturing Division, Benicia, Calif., permitted installation at the record rate of three a week. The innovation consisted of using fabricated steel plate girder construction in place of conventional rolled steel beams for the arms and vertical girders, resulting in a simpler and lighter gate. First power from Priest Rapids Dam went on the line in mid-September. Engineer on the project is the Harza Engineering Company, and the contractor Merritt-Chapman & Scott.

Big Road Machines on the Job in Maryland

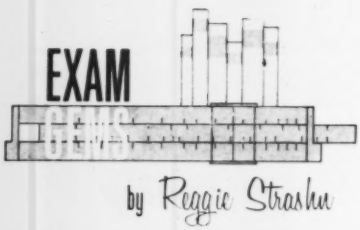
Speeding highway construction in suburban Maryland is Rex hydrocycle paver (background, left) followed by Blaw-Knox spreader. They are laying first 6-in. course of concrete for 25-ft-wide pavement near intersection of New Hampshire Avenue and Route U.S. 29 in Burnt Mills, a suburb of Washington. Wright Construction Company, of Columbus, Ga., holds the paving contract for realignment and relocation work. Second course of pavement will be 3 in. thick. Reinforcement is 6 x 12-2/2 welded wire fabric, weighing 59 lb per hundred square feet. Photo courtesy Wire Reinforcement Institute.





Key tool in constructing a six-mile concrete span across Lake Maracaibo will be a gigantic electric "bridge-building machine" just completed by R. G. Le Tourneau. Unit consists essentially of a 2,000-ton portable three-legged island, equipped with a powerful marine crane (250-ton capacity). As soon as one section of the bridge is completed, the platform will lower itself to the waves, raise its legs from lake-bottom 70 ft below, then move forward to begin work on another section. Built at Le Tourneau's marine facilities near Vicksburg, the machine has just begun a 2,000-mile tow voyage through the Gulf and Caribbean to Venezuela.

Bridge-Building Machine Developed for Venezuela Job



R. ROBINSON ROWE, F. ASCE

EXAMGEM No. 6 was selected as a sequel for the application of 8th-grade arithmetic and the log-log rule instead of confusing formulas to the solution of problems in engineering economics. It asked candidates to compare Plans *A* and *B* on the basis of capitalized cost of perpetual service with 4 percent interest.

Now capitalized cost of a service requiring expenditures at different times is the sum which, with compound interest on unexpended balance, will just provide for all the required expenditures at specified times.

If we set up a special fund *C* to provide for an expenditure *E* at the *n*th year, then by the rule for compound interest

$$C(1+i)^n = E$$

which is equivalent to the form

$$C = E(1+i)^{-n}$$

meaning that capital requirement equals the discounted or present worth of the future expenditure. Terms written for each item of multiple expenditures can be added, since each is in the time-value unit *dollars-now*.

Let's try that on Plan A which cost \$300,000 initially, plus \$10,000 per year for the first 20 yr, plus \$20,000 per year thereafter, plus \$200,000 at the end of every 20th year, viz:

$$C_A = 300{,}000 + 10{,}000\,(1.04^{-1} + 1.04^{-2} + \ldots 1.04^{-20}) + 20{,}000\,(1.04^{-21} + 1.04^{-22} + \ldots 1.04^{-\infty}) + 200{,}000\,(1.04^{-20} + 1.04^{-40} + \ldots 1.04^{-\infty})$$

$$= 300{,}000 + C_1 + C_2 + C_3$$

$$C1 = 10{,}000\,(1.04^{-1} + 1.04^{-2} + \ldots 1.04^{-20})$$

$$1.04\,C1 = 10{,}000\,(1 + 1.04^{-1} + \ldots 1.04^{-19})$$

$$.04\,C_1 = 10{,}000\,(1 - 1.04^{-20})$$

$$C_1 = 250{,}000\,(1 - .456) = 136{,}000$$

$$C_2 = 20{,}000 \cdot 1.04^{-20}\,(1.04^{-1} + 1.04^{-2} + \ldots 1.04^{-\infty})$$

$$= 9{,}120\,(1.04^{-1} + 1.04^{-2} + \ldots 1.04^{-\infty})$$

$$1.04\,C_2 = 9{,}120\,(1 + 1.04^{-1} + \ldots 1.04^{-\infty})$$

$$.04\,C_2 = 9{,}120\,(1 - 0)$$

$$C_2 = 228{,}000$$

$$C_3 = 200{,}000\,[(1.04^{20})^{-1} + (1.04^{20})^{-2} + \ldots (1.04^{20})^{-\infty}]$$

$$= 200{,}000\,(2.19^{-1} + 2.19^{-2} + \ldots 2.19^{-\infty})$$

$$2.19\,C_3 = 200{,}000\,(1 + 2.19^{-1} + \ldots 2.19^{-\infty})$$

$$1.19\,C_3 = 200{,}000\,(1 - 0)$$

$$C_3 = 168{,}000$$

$$C_A = 300{,}000 + 136{,}000 + 228{,}000 + 168{,}000 = \$832{,}000$$

Similarly for Plan *B* which cost \$500,000 initially, plus \$50,000 every 10 yr, plus \$100,000 at the 30th year, viz:

$$C_B = 500{,}000 + 50{,}000\,(1.04^{-10} + 1.04^{-20} + \ldots 1.04^{-\infty}) + 100{,}000 \cdot 1.04^{-30} = 500{,}000 + 104{,}000 + 31{,}000 = \$635{,}000$$

Summarizing, all problems in time-value of money can be expressed in primitive forms of geometric series, which can be added by a simple algorithmic device. Formulas and tables save little time for the expert and usually confuse the plebes.

There is another lesson in the problem—the directive word "compare." Most examinees ignored it or, at most, underscored the values computed for C_A and C_B. Par was a statement like, "Plan *B* is more economical than *A* on the basis of capitalized cost of perpetual service, the higher first cost producing a facility that requires no annual maintenance and less expensive renewals." Watch these directive words, interpret carefully, and comply concisely and precisely.

EXAMGEM No. 7

Our next problem, given by Alaska in May 1954, had a double moral effect; before the 1955 exam unsuccessful candidates renewed their brakes and reviewed torques. The problem read:

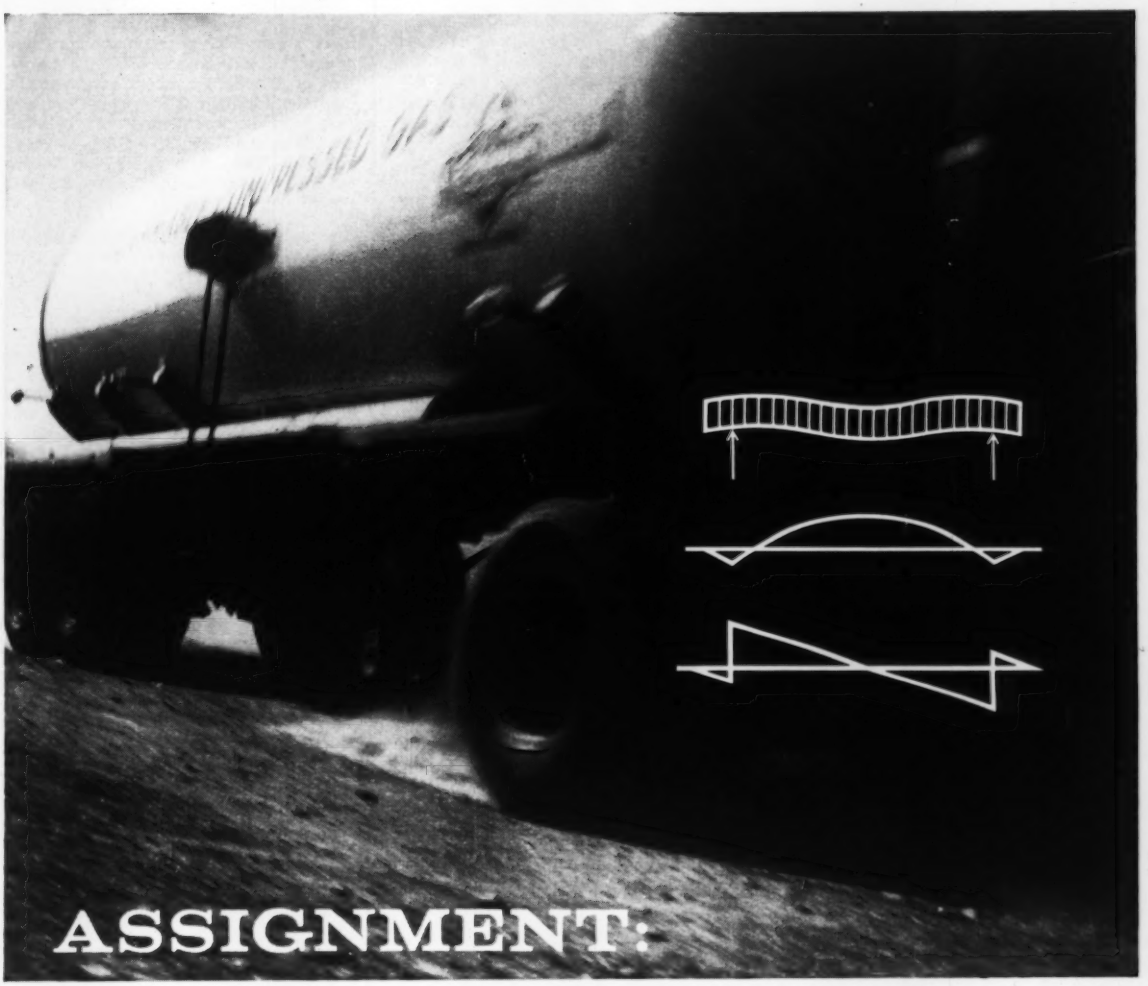
A car weighing 4,000 lb and traveling 50 mph on a level road has a wheelbase of 10 ft. The center of gravity of the car is 2 ft above the roadway and 4 ft behind the front axle. If the coefficient of friction between wheels and road is 0.6, determine the stopping distance for:

(*a*) Rear-wheel brakes
(*b*) Four-wheel brakes

Constructors Chosen For Wanapum Dam

A contract for construction of Wanapum Dam, a \$93 million hydroelectric power project on the Columbia River near Ephrata, Wash., has been awarded by the Grant County Public Utility District to Grant County Constructors, a joint-venture group. The joint venture consists of Morrison-Knudsen Company, Inc. (the sponsor), the Henry J. Kaiser Company, Raymond International, Inc., the Macco Corp., and the F and S Contracting Company.

Work has already started on the project, which includes a powerhouse and an 8,320-ft-long Z-shaped dam with a concrete spillway and earth embankment. When completed in 1964, it will add 831,000 kw to the Northwest power pool.



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Designing for maximum payload means taking maximum advantage of today's high strength steels. Experts who know these steels—from a practical as well as technical standpoint—can give invaluable assistance in the early planning stages. This is the job of our Application Engineering staff.

LPG transport tanks and power shovels are widely divergent areas in which Lukens engineers have helped increase payloads.

The use of Lukens "T-1" steel plate and heads in tanks for hauling LP-Gas has fostered an entirely new design concept in the tank truck field. This high tensile, high yield strength steel (100,000 psi) makes it possible to mount wheels *directly on the tank.* The dead weight of heavy underframes goes into payload.

Working with a major producer of power shovels, our staff suggested tough Lukens "T-1" for buckets, dipper sticks, bucket teeth and other key parts. Lightweight, welded steel plate—rather than heavy castings—added as much as 40% to load capacity.

From these successful projects—and many more—our Application Engineers have gained knowledge and experience of value to design engineers. That's why we say... *if your assignment is strength/weight, let it be our assignment, too.* Contact Manager, Application Engineering, I-10 Services Building, Lukens Steel Company, Coatesville, Pa.

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ASK FOR THE LUKENS "T-1" STEEL BULLETIN

DECEASED

Elmo W. Boehl (A.M. '47; M. '59), age 51, vice president of Tears Engineering, Dallas, Tex., died there recently. Prior to joining Tears Engineering, Mr. Boehl worked for several Texas firms designing highways, storm and sanitary sewers, the Naval Air Training Station at Corpus Christi, and oil refineries and chemical plants.

Frank Wood Bromley (M. 59; F. '59), age 54, since 1942 a member of the Phoenix (Ariz.) architectural firm of Johannessen & Girand, died in Phoenix recently. At the time of his death, Mr. Bromley was a partner in the firm, having previously served as head of the Civil Engineering Department and as chief engineer in charge of construction.

Daniel J. Brumley (M. '08; F. '59), age 94, who retired from the Illinois Central Railroad in 1935 after thirty-one years of service, died on December 6, in Flossmoor, Ill. He was former chief engineer of the railroad and between 1919 and 1926 supervised reconstruction of the system's Chicago terminal.

C. L. Emerson (M. '40; F. '59), age 71, for the past four years consulting engineer with A. Thomas Bradbury & Associates, of Atlanta, Ga., died there recently. A former president of Robert & Company Associates, he was named dean of engineering at the Georgia Institute of Technology in 1945. Three years later he was put in charge of the Institute's expansion program as vice president.

Frank P. Fifer (M. '21; F. '59), age 74, a consulting hydro-civil engineer, died recently at Annapolis, Md. For the past three years he was associated with the Tudor Engineering Company in Washington, D.C., as adviser to the International Cooperation Administration. For fifteen years he was with the Corps of Engineers as a specialist in hydroelectric development, and at one time he was with Hugh L. Cooper and Company of New York, in charge of construction on the Wilson Dam in Alabama and the Dnieprostroy hydroelectric development in Russia.

George Gartner (J.M. '53; A. M. '59), age 43, who joined the Los Angeles Flood Control District in 1953, was killed recently in an automobile accident. An associate civil engineer, he supervised work related to water-spreading activities and studies of ground water basins.

Alfred Gordon (A.M. '28; M. '59), age 71, former engineer in the Bridge Department of the Canadian Pacific Railway, died recently in Montreal, Quebec. After a quarter of a century of service with the railroad, Mr. Gordon left in 1956 to become an engineer with the St. Lawrence Seaway Authority. He held the latter position at the time of his death.

Dwight D. Gross (M. '31; F. '59), age 79, chief engineer of the Denver Water Department for twenty-six years prior to his retirement in 1951, died recently in Denver. After his retirement Mr. Gross served as consulting engineer for the City Water Department. Named for him is the $12,000,000 Gross Dam and Reservoir south of Boulder, Colo., which he helped create.

George W. Lamb, Former Director of ASCE, Dies

George W. Lamb (M. '46; F. '59), age 59, a specialist in structural design, especially bridges, died recently in Topeka, Kans. Mr. Lamb was district engineer for the American Institute of Steel Construction at Topeka from 1945 to 1954, and from the latter year until December 1958 bridge engineer for Howard, Needles, Tammen & Bergendoff at Topeka, working on the Kansas Turnpike and Kansas City's 18th Street Expressway. Since the first of the year he had maintained a consulting practice in structural engineering at Topeka. He served as Director of ASCE from 1950 to 1952.

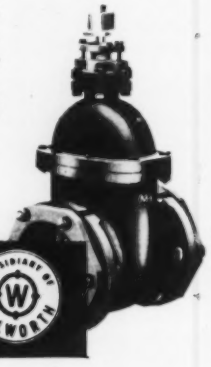
THE POPULATION BOMB

Economists and scientists refer to a rapid increase in the number of people as a "population explosion." U. S. population today is estimated at around 175 million and is increasing at the rate of about 7,500 each day—a new citizen every 12 seconds. Census experts expect U. S. population will be 250 million by the 1980's.

The basis of increased water use is an increase in consumers plus greater consumption per capita. U. S. is experiencing both. Total water use in the U. S. in 1900 was about 35 billion gpd. By 1950 it had increased to 200 billion, in 1959 it is 300 billion, and by 1975 it is expected to be well over 400 billion gpd.

A local water problem may involve insufficient quantity, poor quality and inadequate distribution. Federal, state and local officials and your water works superintendent know what to do. But they cannot do it without wholehearted public support.

This series is an attempt to put into words some appreciation of the water works men of the United States.



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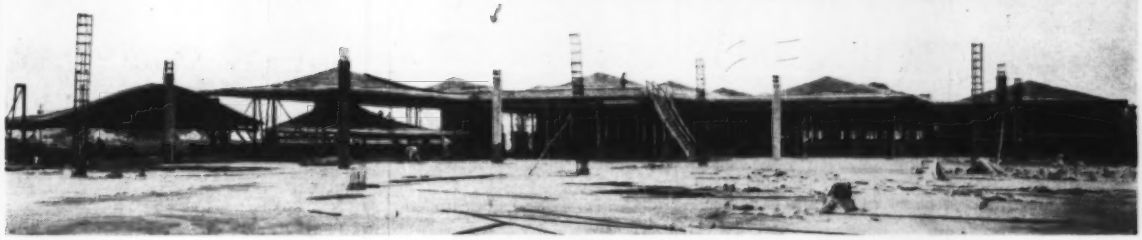
Concrete Hyperbolic Parabaloid Roof



Partially completed fireproof shopping center. Each of the 44 umbrella units is 48'6" x 46'3" and is supported by a single column. The completed building is 196' x 511'.

Provides Large Unobstructed Floor Areas

At Bloomington, Minnesota, this new shopping center has been completed employing a very modern concrete hyperbolic parabaloid roof design—the first of its kind in the Minneapolis area. This type of roof design for single story structures provides large unobstructed floor areas at low cost.

Contractor planning on the job was precise. Careful scheduling and the use of Lehigh Early Strength Cement made it possible to strip and re-use the unique concrete form system in less than half the time which would have been required with regular cement. Only four sets of forms were needed. Eight units—or bays—were poured per week.

This is another example of the advantages of Lehigh Early Strength Cement and modern concrete construction. Lehigh Portland Cement Company, Allentown, Pa.

LEHIGH CEMENTS

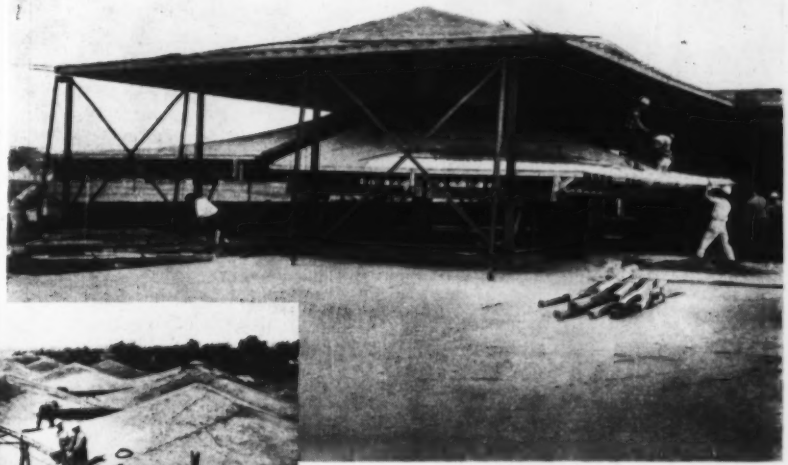
Owner: Bloomington Development Co., Bloomington, Minn.

Architects: Manuel Morris & Robert E. Sixta Assoc., Kansas City, Mo.

Structural Engr.: Dutton Biggs, Kansas City, Mo.

Contractor: George Madsen Construction Co., Minneapolis, Minn.

Ready Mix Concrete: Twin City Ready Mix Concrete Co., Minneapolis, Minn.



As set of forms is lowered, workmen place supplies of reinforcing on it. Form serves as elevator to carry bars to roof for assembly. Each half of the form weighs 4 tons. Four sets of forms were used cyclically for an efficient construction schedule.

Other workmen prepare reinforcing for more roof sections on top of completed concrete "dunes." Concrete shell is 3" thick.

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Overpass at Intersection of Rts. 12 and 77, Sioux City, Iowa. Designer: Iowa State Highway Commission. Contractor: Hobe Engineering Company.

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Giles Louis Marec (A.M. '42; M. '59), age 57, for the past thirteen years structural engineer with the Semet-Solvay Engineering Corporation, now a division of the Allied Chemical and Dye Corporation, died recently in New York City. Immediately before joining Semet-Solvay, Mr. Marec was structural engineer for the New York World's Fair, Inc.

Onie El Roy McMullen (M. '34; F. '59), age 69, consulting engineer of Lansdowne, Pa., died there on October 24th. Mr. McMullen opened his consulting service in 1955 after retiring as regional engineer for the Portland Cement Association in Philadelphia, Pa.

John M. Muddeman (M. '56; F. '59), age 60, consultant to numerous cities, towns, and villages on Long Island, N. Y., and throughout the United States, died recently at Stony Brook, L. I. Prior to founding John M. Muddeman Assocs., in 1932, he was employed by the City of Utica as assistant city engineer. Mr. Muddeman was author of two books, "Know Your Own Town Plan" and "The ABC of Planning and Zoning."

Bernard John Parker (A.M. '57; M. '59), age 59, since 1949 senior design engineer for Charles A. Maguire & Associates, of Providence, R. I., died recently in Warwick, R. I. For ten years, from 1939 to 1949, Mr. Parker served with the Army Corps of Engineers as a civil engineer and principal assistant to the chief of the Specification Section. During World War II he assisted in preparing estimates and specifications for airfield and coastal defense projects for the Army's East Coast range of airfields.

Charles Tilden (M. '13; F. '59), age 86, professor emeritus of engineering mechanics at Yale University's Sheffield Scientific School, died on November 15, in Sydney, Australia. After twenty-one years at Yale, Mr. Tilden retired from his post in 1940. Earlier he had taught at Cornell University, the University of Michigan and Johns Hopkins. Concomitant with his teaching Mr. Tilden served from 1922 to 1942 as a highway research specialist with the Bureau of Public Roads and as a member of the Connecticut Highway Safety Commission from 1936 to 1942.

ASCE Past Director Harry F. Thomson Dies

Harry F. Thomson (M. '39; F. '59), age 72, first executive director of the St. Louis Metropolitan Sewer District, died on November 7, of a heart attack in Mexico City. One of the earliest producers of ready-mix concrete in the country, Mr. Thomson was active in that field for twenty-eight years. From 1927 until 1948 he was president of the General Material Company, St. Louis, and from 1950 to 1955 was vice president of the Material Service Corporation in Chicago. Since his retirement in 1955, he had been active in

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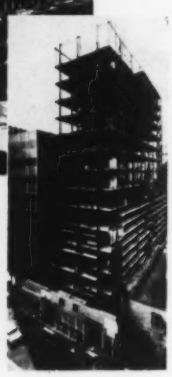
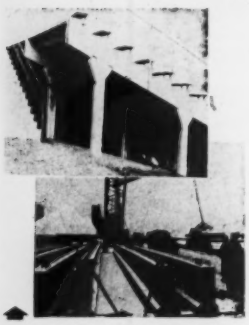


Concrete Pipe Manufactured by F. Hurlbut Co., Green Bay, Wisconsin



Everest High School Stadium Schofield, Wisconsin

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consulting work. Mr. Thomson was a Director of ASCE for the 1945-1947 term.

J. W. Vickrey (M. '46; F. '59), age 67, who became California state highway engineer last October, died in Sacramento, Calif., on December 4. Mr. Vickrey, prior to moving up to the top job in the State Division of Highways, had served for three years as deputy engineer. His death culminated a forty-two-year career with the division.

Frank W. Webster (M. '35; F. '59), age 72, who retired in 1957 from the Tennessee Valley Authority after a number of years of service, died at Knoxville on October 20. Since 1957 Mr. Webster had been highway consultant to the Mid-South Engineering Company.

W. Victor Weir (M. '39; F. '59), age 57, president of the St. Louis (Mo.) County Water Company and five other water utilities in various parts of the country, met an untimely death on November 19 in St. Louis. He began his career as an engineer with the old West St. Louis County Water and Light Company, predecessor of the St. Louis County Water Company in 1923, and worked his way up through the ranks. Mr. Weir served as president of the American Water Works Association from 1950 to 1951 and was chairman of the Metropolitan Plan Association from 1955 until his death. He was elected Honorary Member of AWWA in 1956 and held many other honors.

L. R. Whitted (A.M. '06; M. '59), age 85, retired civil engineer, died recently at Asheville, N.C., where he had lived for the past fourteen years. After a year of teaching at the North Carolina State College, Mr. Whitted joined the federal government as a civil engineer, remaining there for twenty-six years.

Charles Lawson Wooldridge (M. '09; F. '59), age 83, retired president of Charles L. Wooldridge, Inc., of Pittsburgh, Pa., died recently in Winter Park, Fla. Mr. Wooldridge founded the firm bearing his name in 1927 to serve as a consultant to school boards, hospital boards and public service groups generally. In 1934, he was named for the second time superintendent of buildings under the Pittsburgh Board of Public Education.

Les Wyborny (A.M. '56; F. '59), age 43, an engineer with the South Dakota Water Resources Commission at Pierre, died recently in a boat accident. A graduate of South Dakota State College, he was employed by the Federal Government on Case-Wheeler irrigation projects and flood control in Montana, Wyoming, Kansas, and Arkansas before joining the Water Resources Commission.

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Non-ASCE Meetings

American Institute of Consulting Engineers. Winter meeting at the Statler Hilton Hotel, New York, N. Y., Jan. 31-Feb. 5. AICE, Engineering Societies Building, 33 West 39th Street, New York 18, N. Y.

American Institute of Mining, Metallurgical and Petroleum Engineers. Annual convention at the Statler Hilton and Sheraton-Atlantic Hotels, New York, N. Y., Feb. 14-18. AIME, 29 West 39th Street, New York 18, N. Y.

American Road Builders' Association. Fifty-eighth annual convention at the Netherland Hilton Hotel, Cincinnati, Ohio, Jan. 18-21. Randy Russell, Public Relations, ARBA, World Center Building, Washington 6, D. C.

Associated Equipment Distributors. Forty-first annual meeting at the Conrad Hilton Hotel, Chicago, Ill., Jan. 24-28. AED, Convention Department, 30 East Cedar Street, Chicago 11, Ill.

Highway Research Board. Thirty-ninth annual meeting at the Sheraton-Park Hotel, Washington, D. C., Jan. 11-15. Fred Burggraf, Director, HRB, 2101 Constitution Avenue, Washington 25, D. C.

Institute of Transportation and Traffic Engineering, University of California. Twelfth California street and highway conference at the Berkeley and UCLA campuses, Jan. 28-30. Victor W. Sauer, General Chairman, Director of Public Works, Contra Costa County, Calif.

National Society of Professional Engineers. Winter meeting in the Broadview Hotel, Wichita, Kansas, Feb. 18-20. John T. Kane, NSPE, 2029 K Street, N.W., Washington 6 D.C.

New York State County Highway Superintendents' Association. Winter meeting at the DeWitt Clinton Hotel, Albany, N. Y., Jan. 27-29. Harry R. Mason, Secretary, NYSCHSA, Fonda, N. Y.

The School of Public Health of the University of North California. Sixth Radiological Health Seminar at Chapel Hill, N. C., Jan. 25-27. Professor Emil T. Chanlett, Department of Sanitary Engineering, University of North Carolina, Chapel Hill, N. C.

Society of Plastics Engineers. Sixteenth annual technical conference at the Conrad Hilton Hotel, Chicago, Ill., Jan. 12-15. SPE, 65 Prospect Street, Stamford, Conn.

University of Colorado. Annual Rocky Mountain Water and Sewage Plant Operators School at the University Extension Center, 1100-14th Street, Denver, Colo., Jan. 18-22. Assistant Professor Walter A. Weers, Bureau of Continuation Education, 352 Chemistry Building, Rocky Mountain Water and Sewage School, University of Colorado, Boulder, Colo.

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SALES ENGINEER, A.M. ASCE. B.S.C.E., age 35. Twelve years' sales and product application to construction, mining, and quarrying industries. Sales administrative and supervisory experience. C-505.

MANAGEMENT EXECUTIVE, CONSTRUCTION. M. ASCE, age 39. Nineteen years of experience on residential, commercial, industrial, slipform feed-mill construction, from design to completion, foreign and domestic. Have held positions as chief engineer, vice-president and president of construction companies. Excellent organizer, have written a construction handbook. Internationally travelled. Seeks challenging management position. Prefers warm climate. C-506.

LOCATION AND DESIGN SPECIALIST, F. ASCE, from reconnaissance to final plans. Photogrametric computer and/or standard survey methods. Salary or Contract—Domestic or Foreign. Available February 1, 1960. C-507.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., EIT Maryland, age 27. Four years as unrestricted line officer, U.S. Navy; six months as right-of-way engineer for engineering consulting firm; many part time and summer jobs while a student. Currently working on MEA degree. Interested in digital computer programming opportunities. C-508.

CIVIL ENGINEER, A.M. ASCE, B.S., age 32. Nine years' experience as plant engineer, mechanical equipment design, supervision, construction engineer, concrete structure design (limited), special projects engineering. Location desired, Florida. C-509.

CHIEF STRUCTURAL ENGINEER, A.M. ASCE. M.S.C.E., age 33. Ten years of experience in soil mechanics and foundation engineering, design and layout of heavy industrial and process plant structures; three years as chief structural engineer supervising ten to twenty-five engineers and draftsmen, estimating engineering and construction costs. Registered professional and structural engineer—Illinois, Indiana, and Ohio. Location desired, Chicago metropolitan area. C-1019-Chicago.

ENGINEERING GEOLOGIST, M. ASCE, M. AIME, A.B., age 44. Twenty years of experience in exploration geology and mineral engineering, primarily oil and gas; also ground water soils, sedimentation, hydrodynamics, mining and mineral deposit evaluation. Heavy experience report writing, technical and non-technical. Consultant, available immediately. Location desired, prefer Western U.S. or Foreign. C-510.

JUNIOR CIVIL ENGINEER, A.M. ASCE, MSCE, age 26. One year experience on public works estimating design, drafting, inventories, on reinforced concrete and steel bridges and girders, roads, bridges, traffic research. $7,200 per year. Location desired, San Francisco Bay Area. Home: Se-1669.

DESIGNER, HYDRAULIC ENGINEER, M. ASCE, age 55. Registered Civil Engineer in California. Fifteen years of experience on design, construction of highway bridges, dams, aqueducts, water supply; soils, concrete chemical and fluid mechanics laboratory head. $9,600 per year. Location desired, California or Foreign. Se-1263

STRUCTURAL DESIGNER, DETAILER, M. ASCE, CE, age 58. California Civil Engineer License. Thirty years of experience as structural designer for contractors, steel companies, oil refineries and self-employed as consultant. $600 per month. Location desired, San Francisco Bay Area. Se-1546.

CONSTRUCTION SUPERINTENDENT, M. ASCE, CE, age 41. Licensed Civil Engineer California, Louisiana, New York. Experenced as project engineer and construction superintendent on light and heavy industrial construction including steam power plants. Desires position as engineer or supervisor with consulting engineer or contractor. $10,800 per year. Location desired, West Coast. Se-1531.

SOILS OR HYDRAULIC ENGINEER, M. ASCE, PhD CE, age 32. One year charge of soils, hydraulics, stability and foundation analysis for consultant. Four years hydraulic engineer, design of earth dams, irrigation and drainage systems (China). $8,400 per year. Location desired, California or East Coast. Se-1515.

OFFICE ENGINEER, ESTIMATOR, M. ASCE, age 62. Thirty-four years as construction consultant, office and estimate on turnpike, highway. Eight years water supply for city; concrete caisson, corewall, tunnel gatehouse, power house, dam, concrete and steel, survey, map. $8,400-9,000. Location desired, Southern or Central California. Se-1511.

CHIEF ENGINEER, M. ASCE, CE, age 33. Nine years broad civil, structural and mechanical engineering experience, capable of coordination, supervision and design of public utilities, general structures and drainage facilities. Evaluation of existing facilities and compilation and presentation of feasibility reports. $12,500 per year. Se-1471.

FIELD ENGINEER, ESTIMATOR, A.M. ASCE, age 55. Eleven years of experience as field engineer and inspector, chief estimator for missiles manufacturing plant and facilities, air bases, storage tanks, harbors, tunnels, tire manufacturer, public works, Atomic Energy Commission buildings; for constructors, architects, manufacturers. $9,000-10,000 per year. Se-1399.

OFFICE, FIELD ENGINEER, M. ASCE, CE, age 38. Ten years' experience in heavy construction, engineering design, office and field, port facilities, railroad design and construction and estimating. $9,000 per year. Location desired, San Francisco Bay Area. Se-1379.

SENIOR DESIGNER, M. ASCE, CE, age 35. Professional Licenses in California and Washington. Four years as senior engineer doing preliminary plans, cost estimates, design for hydro-electric projects for consultant. Four years as liaison engineer, supervising plans, recommendations, designing hydraulic structures for government. One year design, bids for water supply projects. $8,820 per year. Location desired, San Francisco Bay Area. Se-1402.

STRUCTURAL DESIGNER, M. ASCE, CE, age 36. Registered Civil Engineer in California. Fourteen years of experience on bridges, hydraulic structures, buildings in field, design office and supervision. $9,000 per year. Location desired, Western States. Se-937.

MUNICIPAL ENGINEER, STRUCTURAL DESIGNER, A.M. ASCE, CE, age 33. Registered Civil Engineer in California and Kansas. Seven years' experience

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DESIGNER, FIELD ENGINEER, A.M. ASCE, CE, age 26. Two years of experience in hydraulic and structural design of hydroelectric projects. Also familiar with aerial mapping techniques. $9,600 per year. Location desired, Overseas. Se-1347.

SANITARY ENGINEER, A.M. ASCE, MSCE, age 30. Professional License in Texas and New Jersey. Four years on municipal water and sewer master plans and reports, hydrological and ground water supply investigations, water and sewage treatment plants and pumping stations, underground piping. Also one year as naval architect on structural design and piping for aircraft carriers. Salary open. Location desired, California. Se-1325.

ARCHITECTURAL ENGINEER, A.M. ASCE, Archt-Engr, age 34. Registered Engineer and Architect, Pennsylvania. Nine years of experience in charge of design of architectural, structural, piping, plumbing, heating for military bases, mills, schools, churches, institutional buildings, sewage treatment plants, boiler houses and concrete and steel industrial buildings. $10,200 per year. Location desired, California, Pennsylvania, Florida. Se-1147.

PLANNING ENGINEER, A.M. ASCE, CE(Irrig), age 30. Registered Civil Engineer in California. Eight years of experience in multi-purpose project planning and feasibility studies, hydrology, hydraulics, water pollution investigations, water and sewage treatment and water rights. $9,000 per year. Se-297.

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INSTRUCTOR for Department of Civil Engineering, at least a Master's degree, to teach in the fields of applied mechanics of solids, including fluid mechanics. Will also handle some courses such as surveying, concrete laboratory, etc. Should be interested in research as well as teaching. Opportunity to work for Doctor's degree. Will consider applicant with B.S. at a lower salary, with rank of Assistant Instructor. Salary, for Instructor, $5,460 for ten months. Available February 1, 1960. Must be U.S. citizen. Location, New England. W-8278.

CIVIL ENGINEERS. (*a*) Field engineer, graduate, for position with major gas transmission company; to age 35, with experience in office design, location and property surveys. Must travel. (*b*) Pipe line surveyor, to age 35, with experience in pipe line location, office and field drafting necessary. Location, Midwest. W-8262.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of for members, $4.50 per quarter or $14 per annum for non-members, payable $3.50 per quarter or $12 per annum in advance.

RESIDENT ENGINEER on the construction of a cement plant, construction background, with substantial experience in building cement plants and installing cement plant equipment, wet or dry. Must be able to supervise construction from a management standpoint from start to finish; modify existing designs where required and provide substantial supervisory experience in field and office and on cement plants only. Must be able to pass overseas medical exam, live in a hot humid climate; one and one half to three year contract with family if desired. Salary, $18,000-$24,000 a year. Location, southern Asiatic Country. W-8256.

CIVIL ENGINEER, registered in Florida, graduate civil, for the design and supervision of utilities in sub-division and small municipalities. Utilities consist basically of roads, storm sewers, sanitary sewers and water mains. Salary, $6,000-$8,000 a year. Location, Florida West Coast. W-8254.

FIELD ENGINEER: CE, young. Recent graduate or some experience; able to assist in field and office operation and occasionally some lab work on foundations investigations, observing and supervising test drillings, assist in control of compactions and grading, assist in observing and reporting foundations and pile driving. For buildings, road work, earthdams, canals, subdivision. For small and growing consultant. $6,000-$7,200 per year. Location, Marin County, Calif. Sj-4865.

ASSISTANT PROJECT ENGINEER, CE, Registered in California, or able to pass examination. Several years' experience in local land area studies able to do board work, make layouts to evaluate collected data, field notes and computation and make reports and recommendations. For consulting engineer. To $9,000 per year, depending on experience. Location, San Francisco Peninsula. Sj-4826.

ASSOCIATE CIVIL ENGINEER, age open, minimum four years of experience and Registered Civil Engineer in California. Supervise highway or bridge design, site or subdivision, construction or administration of contract construction. U.S. citizen. Location, Central California. $7,800-$9,400 per year. Sj-4722.

ADVISORS, minimum requirements, engineering degree and registration, also fifteen years' experience desirable. Man with family considered, but single man preferred. Complete logistic support provided. (*a*) CONSTRUCTION ACCOUNT, advise comptroller. (*b*) CONTRACT AND PROCUREMENT SPECIALIST, advise chief of Supply Division. $12,000 per year. Location, Korea. For architect-engineer. Sj-4873.

SANITARY AND CIVIL ENGINEER, BS or MS in CE, age open. Minimum of two years of experience in water supply and sewage facilities design, report and specification writing. Knowledge of hydraulics, hydraulic structure design or water supply and treatment design or sewers and sewage treatment design. Must design large water treatment plant, reservoirs, pumping station, prepare reports and write specifications. Reports to senior or project engineer. Location, Southern California. Salary open. Sj-4869-R.

INSIDE SALES ENGINEER, construction background, to age 45. Able to take off and quote from standard price books on specialty doors, for sales to millwork plants, lumber dealers, contractors. Strictly an office job and must be able to rapidly take-off from construction plans in builders exchange offices. For wholesale distributor of national product. $6,000-$7,200 per year. Location, San Francisco. Sj-4866.

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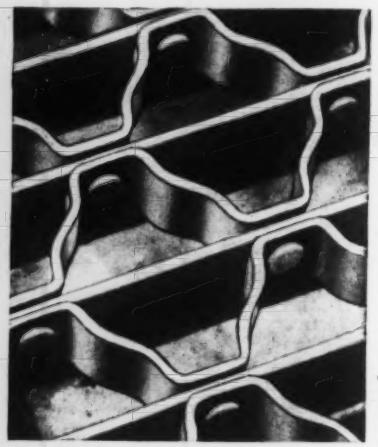

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Applied Solar Energy Research

Second Edition

The work of laboratories and of individuals actively engaged in solar energy research is described, and a bibliographical survey is made of the field. Arrangement of the bibliography is by broad subject divisions which include such aspects as solar radiation and its effects, and the use of solar energy as heat-low temperature conversion, as heat-high temperature conversion, and as light. (Published by the Association for Applied Solar Energy Research, 3424 North Central Avenue, Phoenix, Ariz., 1959. 275 pp., bound. $7.50.)

Appraisal and Valuation Manual

Topics discussed range from the valuation of Currier and Ives prints and early American pewter to the appraisal of large-scale housing projects and the Empire State Building. Included are articles on tax equalization, capitalization rates, buyer motivations, depreciation, obsolescence, ad valorem assessment, structural costs, accounting concepts, condemnation, backward valuation, specialty financing, and other related topics. (Published by The American Society of Appraisers, La Salle Building, 1028 Connecticut Avenue, N.W., Washington 6, D. C., 1959. 525 pp., bound. $15.00.)

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Das Arbeiten Mit Gleitschalungen

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A comprehensive treatment on the use of moving or sliding forms for concrete work. The author discusses general principles, modern lifting devices, organization of the construction plant, the proper composition of the concrete, transportation and storage of forms. Practical examples are included. (By Franz Böhm. Wilhelm Ernst & Sohn, Berlin, Germany. 147 pp., 1959. paper. 21 D.M.)

The Atom and the Energy Revolution

A broad introduction to atomic energy and its industrial and social implications. The author discusses world energy resources and demand, new sources of energy, the atom and its energy, methods of releasing atomic energy, sources of natural materials for atomic energy development, the exploitation of atomic energy, and political and commercial organizations for atomic energy development. (By Norman Lansdell. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y., 1958. 200 pp., bound. $6.00.)

Atomic Energy in the Soviet Union

Although the United States and Great Britain have both published complete reports on the development of their atomic energy program, Soviet Russia has never done so. This book is an attempt to fill this gap by providing an overall review of the history, present scope, and future possibilities of Soviet nuclear research and development. The basis for this book was obtained by systematically scanning many thousands of Soviet newspapers and technical journals, and represents as complete a picture of the situation as is now currently available. (By Arnold Kramish. Stanford University Press, Stanford, Calif., 1959. 232 pp., bound. $4.75.)

Automation and Society

A collection of papers which examine the present and potential impact of automation on society, such as its application to critical industries in the American economy and the problems it raises in the areas of education, leisure, politics, and business and public administration. The final paper by two Russian authors gives a picture of automation in the Soviet Union. A glossary of automation terms and thirty-seven short case histories are also included. (Edited by Howard Boone Jacobson and Joseph S. Roucek. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y., 1959. 553 pp., bound. $10.00.)

Coastal and Submarine Morphology

A translation from the French, this volume discusses coastal geomorphology in considerable detail, and submarine geomorphology in somewhat less detail. The part dealing with coastal geomorphology includes the various forces involved, shoreline movements, coastal features related to sea action, classification of coasts, and coastal evolution. The section on submarine geology describes the continental margin and the deep-sea floor. (By André Guilcher. John Wiley & Sons Inc., 440 Fourth Avenue, New York 16, N. Y., 1958. 274 pp., bound. $6.50.)

Concise Dictionary of Science

Concise definitions of terms and concepts pertaining to the various fields of science. In addition to the more standard terminology, coverage is given to the newer sciences of virology, cytogenetics, radio-chemistry, high energy and solid state physics, etc. (By Frank Gaynor. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y., 1959. 546 pp., bound. $10.00.)

The Corps of Engineers: Troops and Equipment

An account of the manner in which the traditional tasks of American military engineers changed and new ones developed in response to the tactical and logistical demands of World War II. The volume is based on intensive research into the voluminous records of the Corps of Engineers, and constitutes one of the volumes in the series "United States Army in World War II". (By The U.S. Army, Office of the Chief of Military History, U.S. Government Printing Office, Washington 25, D. C., 1958. 622 pp., bound. $4.00.)

CRSI Design Handbook

This manual presents finished designs of reinforced concrete members, giving concrete sizes and reinforcement. The need for charts and diagrams has been eliminated in the safe load tables, and knowing load and span, the designer may immediately obtain information relating to concrete outlines and reinforcemg steel. The basic theories of concrete design have been included for those who prefer to make their own design computations. A brief summary of formulas for ultimate strength design is included with necessary charts. (Prepared by R. C. Reese. Concrete Reinforcing Steel Institute, 38 South Dearborn Street, Chicago 3, Ill. 447 pp., 1959. bound. $6.00.)

The Design of Prismatic and Cylindrical Shell Roofs

Simplified methods of design are given for prismatic and curved cylindrical shells of any geometric form, under varying conditions of loading, support and continuity. Approximation methods are applied throughout, and only a small number of linear equations have to be solved. Fully worked out examples illustrate the application of the methods described. (By David Yitzhaki. Haifa Science Publishers, Haifa, Israel, 1958. 253 pp., bound.)

Dock and Harbour Engineering

Second Edition

The second of four volumes, this book deals with the general design of harbors, including such aspects as tides and waves; marine and submarine surveying; breakwaters and pierheads; jetties, piers, and landing stages; entrance channels; and channel demarcation and moorings. A wide variety of illustrated examples are included to supplement the text, and in addition full lists of references are given to facilitate further investigations of particular topics. (By Henry F. Cornick. Charles Griffin & Co., Ltd., London, England, 1959. 344 pp., bound. £6. 6s.)

Estimating Structural Steel

Methods for compiling profitable bids on bridges, buildings, and other types of construction are described. Stressing the estimator's point of view, the book ranges from simple classes of structural framing to complex jobs, and from the fabricating shop to the work in the field. The various equipment, tools, materials, and labor involved in all phases of fabrication and erection are covered, and details are given on how to estimate columns, beams, connections, built-up sections, and girders. A special chapter treats structural aluminum and the advantages of aluminum framing. (By George A. Saunders. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. 274 pp., 1959. bound. $9.50.)

Estimator's Piping Man Hour Manual

The charts included for determining man hour requirements are based on an analysis of many time and method studies, and of the actual cost of various operations both in the shop and field. (by John S. Page and James G. Nation. Gulf Publishing Company, Houston, Tex., 1958. 146 pp., bound. $7.50.)

Foundation Design and Practice

Economy in the design and building of foundations is stressed. Beginning with the choice of site and a consideration of the demands of the superstructure, the author then describes various foundation types and how they are installed. He continues with laboratory and field testing of soil and foundation units, specifications and contracts, and building codes. A basic design procedure is proposed and described in the concluding section. The efficiency of this procedure is based in large part on the frequent use of battered pile and caissons and tension units. (By J. H. Thornley. Columbia University Press, 2960 Broadway, New York 27, N. Y. 298 pp., 1959. bound. $15.00.)

Geology for Engineers

Second Edition

After a discussion of the most important minerals, this text deals with igneous activity and products of weathering, derives the sediments, and follows the deformation and metamorphism of rocks. Field methods and geologic maps are then discussed, and followed by the work of surface agents. The treatment of earth movements, which uses Sharp's classification of landslides, provides a description of the prevention and control of such phenomena. The present edition adds new material as well as deleting older material, and in particular introduces the fundamentals of soils mechanics. (By Joseph M. Trefethen. D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, N. J. 632 pp., 1959. bound. $8.50.)

Handbook of Heavy Construction

The requirements of a construction job, the performance of major field operations, the operation and maintenance of equipment, and the best use of modern materials are surveyed in this handbook. Tables of data for figuring cost factors are also included. There are specific chapters on excavators, tunnels, explosives, dewatering, precast and prestressed concrete, welding, bituminous pavements, cofferdams and caissons, pile driving, and many other aspects of heavy construction. (Edited by Frank W. Stubbs, Jr. McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y., 1959. Various pagings, bound. $18.50.)

High Speed Computing

The subject of computing is approached from the point of view of the user, with particular emphasis on programming. Following an elementary introduction, two British computers, the EDSAC and the DEUCE, are considered in detail, and the problems of storage and "logical design" of computing circuits are discussed. The concluding portion is concerned with applications in science and research, The Monte Carlo method, control of industrial processes by computers, and the machine translation of languages. (By S. H. Hollingdale. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. 244 pp., 1959. bound. $5.00.)

Highway Research Board Proceedings, 1958

This annual volume contains papers broadly grouped under economics, finance, and administration; design; materials and construction; maintenance; traffic and operations; soils, geology, and foundations. The more extensive papers deal with administration of highway transportation functions, frequencies of various levels of stress in highway bridges, measurement of viscoelastic properties of bitumens under dynamic loadings, and structural and textural influences on thermal conductivity of soils. (Published by the National Academy of Sciences—National Research Council, Washington 25, D. C., 1959. 619 pp., bound.)

Mechanics

Second Edition

Part I: Statics. The resultants of force systems and the equilibrium of force systems are presented as are structures, distributed forces, and friction. A chapter is devoted to the principles of virtual work and shows the type of problems for which this method is superior. Full use of graphic procedures is made whenever they are of advantage, and problems are included which emphasize practical engineering situations. In this edition some of the chapters have been rewritten and many new problems have been added.

Part II: Dynamics. Among those aspects of the subject covered are kinematics; kinetics; force, mass, and acceleration; impulse and momentum; and periodic motion. Appendices deal with vector methods and moments of inertia. In the present edition greater distinction is made between absolute and relative motion analysis in the chapter on kinematics, and greater emphasis is placed on the formulation of problems in particle kinetics by means of the differential equation of motion. In the treatment of work and energy a new section on virtual work is included which not only helps in solving certain types of problems but provides a stepping stone to advanced theory. (By J. L. Meriam. John Wiley and Sons, Inc. 440 Fourth Avenue, New York 16, N. Y., 1959. 813 pp., bound. $5.00 each.)

Nomography

Second Edition

A text that provides a working knowledge of the basic theory and construction of charts involving straight line scales, curved scales, and combination of the two. In this expanded edition new chapters are presented on circular nomograms, projective transformations, and the relationship between concurrency and alignment nomograms. In addition a number of new problems and examples are introduced. An appendix includes 58 nomograms from various scientific fields. (By A. S. Levens. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1959. 296 pp., bound. $8.50.)

Principles of Pavement Design

The basic principles that apply to the design of airfield and highway pavements are presented, and data is provided for establishing the design criteria to fit the many conditions that may be encountered in practice. Both theoretical and practical aspects of the field are covered in sections dealing with the properties of pavement components, design tests, the design of flexible and rigid pavements, and pavement evaluation and strengthening. Examples illustrate the various design methods described. (By E. J. Yoder. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 569 pp., 1959. bound. $13.25.)

Vistas in Astronautics

Volume II

These papers which were presented at the Second Astronautics Symposium, survey and evaluate the progress made towards the solution of the myriad problems related to extra-atmospheric research. The areas discussed include space environment and vacuum research; control and populsion of vehicles outside the atmosphere; departure, space navigation, and re-entry problems; and the earth's moon. Those areas which should be emphasized to facilitate future space exploration are indicated. (Edited by Morton Alperin and Hollingsworth F. Gregory. Pergamon Press, 122 East 55th Street, New York, 22, N. Y. 318 pp., 1959. bound. $15.00.)

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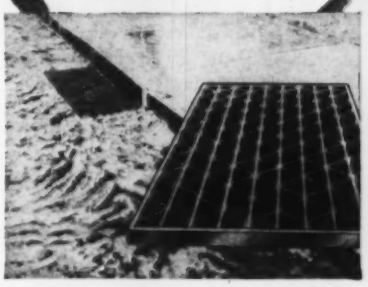

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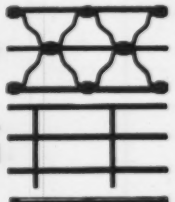

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Architects: Richard S. Colley, Corpus Christi, Texas, O'Neil Ford, San Antonio, Texas. Associates: A. B. Swank, Dallas, Texas, S. B. Zisman, San Antonio, Texas.

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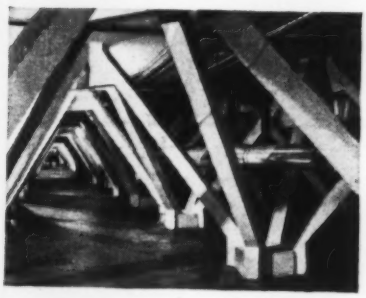

Concrete V-tetrapods form space truss between floors

Four-legged, 5,000 psi precast concrete tetrapods act as diagonals for an 8-ft. deep space frame formed with upper level floor slab and lower level prestressed ceiling slab. The truss formed resists heavy shear forces, retains flexibility of utility arrangement.

Consulting engineer on shells: Felix Candela. Consulting engineer, general structure: Wallace Wilkerson.

For free literature *on shell construction (distributed only in U.S. and Canada) write to Portland Cement Association, Dept. 1-13, 33 West Grand Ave., Chicago 10, Illinois.*

Applications for Admission to ASCE, Oct. 31-Nov. 28, 1959

Applying For Member

(New Designation)

JACOB WALKER ABBEY, San Bernardino, Calif.
JOHN WILLIS ALEXANDER, Surrey, England
MASANAMUTHU BAKKIANATHAN, Calcutta, India
ALBERT JOSEPH BEDARD, SR., Harrisburg, Pa.
LUTHER EDWARD BELL, Houston, Tex.
CHARLES PHILLIP BENZIGER, Niagara Falls, N. Y.
THOMAS JOHN BEVACQUA, New York, N. Y.
PAUL WILLIAM BIERSTEIN, Manila, Philippines
MURRAY IRVIN BRILL, Saigon, Viet Nam, Indo China
EDWARD LINUS BROWN, Middletown, Ohio
MAURICE ALEXANDER BUCKLEY, San Leandro, Calif.
JEAN EVANS BUSH, New York, N. Y.
CHARLES LYNN CONNER, Baton Rouge, La.
MARTIN LAWRENCE DOMB, Ridgefield, N. J.
NARENDRA KUMAR DWIVEDI, Omaha, Nebr.
CLAIBORNE POWELL EAST, Orange, Tex.
HENRY FERLING, Redondo Beach, Calif.
ROY ELDON FREDERICKSEN, Modesto, Calif.
WILLIAM TEAGUE GAY, JR., Boston, Mass.
MUTHUNARAYANA BANGARUSAMI GOPALAKRISHNAN, Troy, N. Y.
ALEXANDER PORTER GOUDY, Hong Kong
BERNARD JAMES GREULICH, Fresno, Calif.
KARL HEINZ GUNTHER GARBRECHT, Ankara, Turkey
JAMES SHOICHIRO HARA, Honolulu, Hawaii
JOHN JACKSON HAYNES, Arlington, Tex.
EDWARD FRANCIS HERTKORN, Philadelphia, Pa.
ROBERT HUGH HOCKBERGER, Calumet City, Ill.
RICHARD GEORGE HOPPER, Niagara Falls, N. Y.
BRENDAN PATRICK KENNEDY, Baghdad, Iraq
GEORGE EDWARD KIRK, JR., Albany, N. Y.
DAVID DOUGLAS KNOX, Asuncion, Paraguay
NORMAN OLIVER KRUEGER, Minneapolis, Minn.
KENNETH ROYCE KVAMMEN, Los Angeles, Calif.
ANG-TSUNG LIU, Detroit, Mich.
JOHN MAKARETZ, Cambridge, Mass.
EARL JOSEPH MARTEL, Baton Rouge, La.
ROBERT KERR MATTHEWS, Pittsburgh, Pa.
JOHN DANIEL MCELHENY, Balboa Heights, Canal Zone
GROVER CLEVELAND MCLURE, JR., Oklahoma City, Okla.
GEORGE JOHN MEGAREFS, Chicago, Ill.
JULIAN GILBERT MIDDLETON, Los Angeles, Calif.
FREDERICK JOHN NELSON, Westfield, N. J.
TADEUSZ ZBIGNIEW OSTOJA-STEBLECKI, Cleveland, Ohio
ALFRED JOHN PORTEOUS, Indianapolis, Ind.
HAROLD CURTIS POULSON, Philadelphia, Pa.
GEORGE REIDER, New York, N. Y.
FELICIANO REYNA-PLAZA, Caracas, Venezuela
JAMES ROBERT ROMANS, Rio de Janeiro, D. F. Brazil
JOHN BRAWNER SMITH, Bangkok, Thailand
BENJAMIN IRVING STEGALL, Atlanta, Ga.
WILBUR ALEXANDER STEVENS, Savannah, Ga.
ZOLTAN STULBERGER, Flushing, N. Y.
LEONIDAS CONSTANTINOS STYLIANOPOULOS, Athens, Greece
TSOONG TUH SUNG, Sarawak, Borneo
MARIO ORLANDO TOGNAZZINI, Los Angeles, Calif.
GEORGE PALACHERIL VARGHESE, Denver, Colo.
KIMON K. VLASTOS, Athens, Greece
ORIN B. WEAVER, LaPorte, Ind.
ARTHUR I. WESTRICH, Silver Spring, Md.
WAYMAN CHUNG WING, New York, N. Y.
KENNETH HENRY YARNELL, Franklin, Pa.

Applying for Affiliate

JOHN FRANCIS MANN, JR., La Habra, Calif.
HOWARD HAMILTON WALDRON, Seattle, Wash.

Applying For Associate Member

(Old Designation)

LAXMINARAYAN VISHNUDATTA KUMAR, Navsari, India
DANIEL CLIFFORD MCKAY, JR., Groton, Conn.

Applying For Associate Member

(New Designation)

HANS ANKER KRUSE AGERSCHOU, Gainesville, Fla.
EUGENE LEE AMAZON, Rome, Italy
ROBERT BROWN ANDERSON, Pittsburgh, Pa.
ANAND SWARUP ARYA, Urban, Ill.
KONRAD BASLER, Bethlehem, Pa.
EDWARD STOREY BELL, Ontario, Canada
LUIS DESIDERIO BELTRAN, Mayaguez, Puerto Rico
JOHN JOSEPH BILSKI, Harrisburg, Pa.
RICHARD FRANCIS BRISSETTE, Pittsburgh, Pa.
RAYMOND JOHN BULTHUIS, San Diego, Calif.
RICHARD CAMINO, New York, N. Y.
RICHARD BURKE CONNELLY, Knoxville, Tenn.
BERNARDO DESCHAPELLES Y DUQUE, Havana, Cuba
JAMES ALBERT DIXON, JR., Orangevale, Calif.
SCHAEFER JAMES DIXON, Sacramento, Calif.
JOSEPH JOHN FLANNAGAN, New York, N. Y.
PHILIP HARRY JONES, Downsview, Ont., Canada
ALI YILMAZ KARATABAN, Ankara, Turkey
CHARLES WILLIAM KEITH, Helena, Mont.
JOHN BAPTIST PERCY KENNEDY, Downsview, Ontario, Canada
NATARAJAN KRISHNAMURTHY, Boulder, Colo.
MANTRAVADI LAJPAT RAI, Knoxville, Tenn.
LEUNG-KU STEPHEN LAU, Honolulu, Hawaii
ALAN MICHAEL LEVY, London, England
MILTON ALBERT LOVELACE, Fresno, Calif.
ROBERT DEWITT LUCE, Indianapolis, Ind.
WILLIAM JOSEPH LUEBBERT, Kansas City, Mo.
CHUN MIH, Minneapolis, Minn.
SHAUKAT MIRZA, Madison, Wis.
MILTON GEORGE MITCHELL, Albany, N. Y.
WILLIAM GEORGE MOONEY, New York, N. Y.
IRVATHUR VASUDEVA NAYAK, Chandigarh, India
CLAYTON BEWLEY NEILL, JR., Carmel Valley, Calif.
DAYARATNAM PASALA, Boulder, Colo.
NEFTALI PENALOZA ROSAS, Caracas, Venezuela
MICHAEL RIDDIFORD, Washington, D. C.
WILLIAM READ SAMPLES, Pasadena, Calif.
ARNOLD EDWARD SCHWARTZ, South Bend, Ind.
VINOD VANDRAVANDAS SHETH, Chicago, Ill.
HECTOR SILVA, Denver, Colo.
BIBHUTI PRASANNA SINHA, Boulder, Colo.
ERNEST THOMAS SMERDON, College Station, Tex.
NICK WHITE STIEGLITZ, San Francisco, Calif.
WILLIAM EVAN STILLMAN, Chester, Pa.
CHARLES GRAYSON SUDDUTH, Los Angeles, Calif.
TSUTOMU TEE TAKAHATA, Cleveland, Ohio
HERMON BANCROFT THOMPSON, Glasgow, Scotland
WILLIMA BAKER TIMMERMAN, JR., Augusta, Ga.
LLOYD EDWARD TOWEVS, Kansas City, Mo.
CARL JOHN TURKSTRA, Urbana, Ill.
GARY ZANFORD WATTERS, Chico, Calif.
METE YALCIN, Junction City, Kans.
TIEN-SHENG YANG, Oklahoma City, Okla.
HECTOR M. ZAPATA, Roosevelt, Puerto Rico
DAVID FERDINAND ZEGEL, Atlanta, Ga.

[Applications for the grade of Associate Member from ASCE Student Chapter Members are not listed.]

New Publications

Concrete practices in the USSR . . . . A report on the visit of an American delegation to observe concrete and prestressed concrete engineering in the USSR has been published by the Portland Cement Association. Included in this most timely publication are the Americans' impressions of research, design and materials, production, construction and education in the field of concrete. Inquiries concerning the report should be addressed to the Portland Cement Association, 33 West Grand Avenue, Chicago 10, Ill.

Water pollution . . . . Water, our most important resource, is the subject of a recent publication of the U. S. Public Health Service. Entitled "The Water Pollution Control Program of the U. S. Public Health Service," the publication outlines some of the things that have been done during the past two years under the Federal Water Pollution Control Act of 1956. Among the topics included in the report are legislative history, administration of the program, collection of necessary information, technical assistance offered by the Public Health Service, construction and research. This report sells for 25 cents, and requests should be sent to the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Reclamation program . . . . Achievements of the Federal Reclamation Program are presented in a Congressional Committee Report, entitled "Reclamations: Accomplishments and Contributions", reprinted by the Bureau of Reclamation. The report touches on some of the problems of the program, but major emphasis is placed on its positive physical accomplishments and contributions to the economy of both the West and the nation. No attempt was made to evaluate the program in this report. Inquiries should be directed to the U. S. Government Printing Office, Washington 25, D. C.

Highway research . . . . The varied investigations conducted by the Highway Research Board are reported in a series of bulletins. Recently announced are Bulletin 204, "Asphalt-Soil Stabilization," $1.00; Bulletin 205, "Highway Laws," 80 cents; Bulletin 215, "Bituminous Patching Mixtures and Seal Coats," 80 cents; and Bulletin 216, "Landslide Occurrence and Analysis." Special Report 37, entitled "Administrative Structure of Local Rural Road Organizations," sells for $1.20. Special Report 40, entitled "Water and Its Conduction in Soils," comprises the papers in an international symposium presented at the Board's 1958 annual meeting. It is priced at $6.00. Two annotated bibliographies are also available. They are Bibliography 23, "Mineral Aggregates" (1958 revision), and Bibliography 24, "Stabilization of Soil with Calcium Chloride." They are $2.20 and $2.00, respectively.

News of Engineers

(Continued from page 24)

Morris Cohn, editorial director of *Water Works Engineering* and *Wastes Engineering,* is currently surveying water supply practices, sewage treatment methods, and pollution control conditions in Israel, Italy, France, and England. While abroad he will also represent the Federation of Sewage and Industrial Wastes Associations at the Israel Association of Sanitary Engineers.

Edward H. Sokolowski has been appointed chief engineer of the San Antonio, Tex., office of Vogt, Ivers, Seaman and Associates. Formerly, he was the firm's project engineer in Cincinnati, Ohio. Part of Mr. Sokolowski's new job involves coordinating engineering operations with the International Aerial Mapping Company, an affiliate.

Mason G. Lockwood, a partner in the Houston (Tex.) firm of Lockwood, Andrews & Newnam, was awarded a silver plaque by the Texas Section at its fall meeting in Fort Worth, for his many services to Texas on the state and local level. Mr. Lockwood is a Past-President of ASCE.

Carl B. Meyer retired recently as principal hydraulic engineer for the California Department of Water Resources at Sacramento after thirty-six years in state water resources work. His first job with the state was with the former division of engineering and irrigation in 1922, a predecessor agency to the State Department of Water Resources.

Chester A. Ring, III, has left the American Water Works Service Company, of Philadelphia to become superintendent and chief engineer of the Plainfield-Union Water Company, Plainfield, N.J. Mr. Ring, who was distribution engineer with American Water Works, succeeds **Conrad W. O'Connell,** who died in September.

New in Education

NSF give aways . . . The *National Science Foundation* announced on November 12 the award of grants totaling about $9,200,000 to thirty-three colleges and universities to support Academic Year Institutes for science and mathematics teachers. This will be the fifth year of this program, whose purpose is to help teachers improve their subject matter knowledge through a year's advanced study on a full-time basis. Information and application forms can be obtained from the directors of the individual Institutes, not from the National Science Foundation . . . *Lehigh University* has been awarded a grant of $19,900 by the Foundation for the support of basic research on the reaction between lime and minerals commonly found in soils. Dr. Roy J. Leonard, A.M. ASCE, assistant professor of civil engineering, will direct the study during the next two years.

A new building on the Cornell campus . . . Hollister Hall, a new $2,000,000 civil engineering building on the *Cornell University* campus, bears the name of one of America's leaders in engineering education, Professor Emeritus S. C. Hollister, F. ASCE, former Director of ASCE and former Dean of the Cornell College of Engineering. The building was donated by Spencer T. Olin, of Olin Mathieson Chemical Company, in memory of his father, the late Franklin W. Olin.

Iowa State gets a reactor . . . The 10-kw, water-moderated, graphite-reflected reactor at *Iowa State University* at Ames, now in operation, will be used for instruction and research in nuclear engineering and allied fields at the University's College of Engineering. The reactor was brought to the initial condition of a self-sustained reaction on October 19 with Dr. Glenn Murphy, F. ASCE, chairman of the Nuclear Engineering Administrative Committee of the University at the controls.

Sanitary engineering research grant . . . Simplified methods of assessing water quality are the goal of a *University of Cincinnati* research project under an initial grant of $8,165 from the United States Public Health Service. Results of the project may indirectly contribute to preservation of fish life and maintenance of pure water supplies, according to the project's principal investigator, J. D. Eye, M. ASCE, associate professor of sanitary engineering at the University.

The Partners of
Parsons, Brinckerhoff, Hall & Macdonald
announce that effective January 1, 1960
the name of the firm will be changed to

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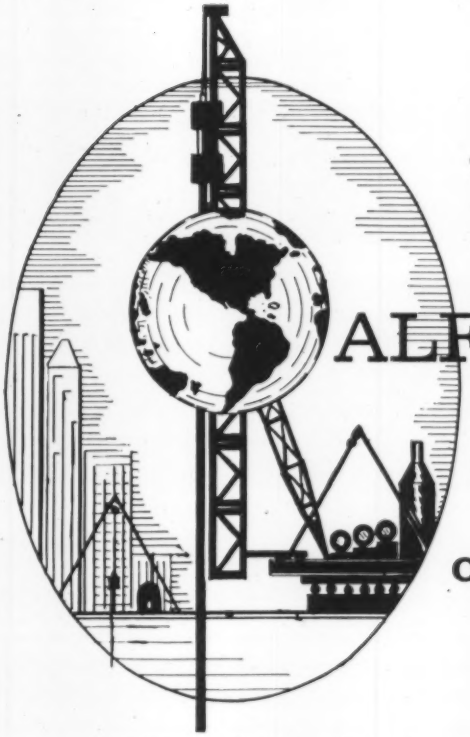
Positions Announced

San Diego County. There exists an immediate opportunity for an assistant sanitary engineer, up to age 64, with the equivalent of a four-year college education in civil engineering, plus two years of professional engineering experience of of which one year must have been in designing sewage or water treatment plants, pumping stations or industrial plant systems. Salary range is $283.20 to $312.80 biweekly. Applications should be sent to Clayton G. Swanson, Director of Personnel, Department of Civil Service and Personnel—Room 403, Civic Center, San Diego, Calif.

U. S. Navy. There is an opening for a structural engineer, GS-12, at $8,810 and a general engineer, GS-13, at $10,130 with the Naval Civil Engineering Laboratory, Port Hueneme, Calif. Applicants must possess an engineering degree plus four years of professional engineering experience, one year of which must have been spent in specialization. Forward application Standard Form 57 to Code 12C11, Placement Section, Industrial Relations Office, Construction Battalion Center, Port Hueneme, Calif.

PLAN YOUR ENTRY NOW!



The Third Annual

ALFRED A. RAYMOND AWARD

ONE THOUSAND DOLLARS

OPEN TO ALL: Practicing engineers, engineering faculty, graduate students and undergraduates. This competition invites papers which will promote ingenuity, originality, and research in the field of foundation engineering as related to the *foundations for structures*. Any aspect of this broad field, theory or practice, is a fit subject. Deadline for all papers is September 1, 1960.

THE JUDGES: FRANK A. MARSTON, Partner, Metcalf & Eddy, Consulting Engineers, Boston, Massachusetts.

WILLIAM W. MOORE, Partner, Dames & Moore, Consulting Engineers, San Francisco, California.

RALPH B. PECK, Professor of Foundation Engineering, University of Illinois, Urbana, Illnois.

"These awards by Raymond International Inc., are a step in the right direction. By lending encouragement to research in the foundation field, they can stimulate interest in civil engineering research generally. More of it must be done if the art of construction is to advance."

—Waldo G. Bowman, Editor, Engineering News Record.

WRITE NOW FOR RULES AND REGULATIONS

ALFRED A. RAYMOND AWARD, Dept. C, Room 1214, 140 Cedar Street, New York 6, N. Y. Telephone: COrtlandt 7-7070.

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Pavement Test Coring Rig

COMPLETELY SELF-CONTAINED with its own power plant and built-in 100-gal water tank, the new pavement test coring rig manufactured by Acker Drill Co., Inc., is trailer mounted for towing by car, jeep, station wagon or truck.

Units already in operation are easily producing up to 65 perfect cores per eight hour shift. Materials ranged from asphalt to reinforced concrete and applications included new jet runways, highways and bridge abutments.

A minimum of moving parts, adequately sealed and lubricated, reduces wear and maintenance. Absence of a separate transmission eliminates overall weight and further reduces repairs and service. —CE-1

New Electronic Switch

LIGHTGUARD, ONE OF THE smallest, most versatile automatic light-operated switches on the market, is offered by Schacht Electronic Manufacturing Company.

Only 1¾ in. in diameter, it is suitable for installation in existing lighting fixture canopies, outlet boxes, post lanterns and in conjunction with mercury plunger-type relays for control of heavier electrical loads; it can be easily adapted to the fixtures of most manufacturers.

The electronic switch is designed to turn on at approximately 1 foot candle and off at 10 foot candles. Currently manufactured models are suitable for tungsten loads up to 300 watts on 120 volts AC circuits. —CE-2

American Ductile Iron Pipe

THE UNDERGROUND PIPING WHICH passes beneath or which is installed adjacent to the new super-highways must have extra strength to withstand the heavier external loads imposed by deeper covers, toughness to meet possible stresses in shifting soils and unstable bedding brought on by deeper and wider earth fills, plus the ability to resist the shock loads imposed by the constant pounding of highway traffic of the future. These extra safety factors are all found in American Ductile Iron Pipe offered by the American Cast Iron Pipe Co. to meet these super-service requirements in conveying gas or liquids.

American Ductile Iron pipe possesses ductile characteristics approaching those of steel combined with the age-old corrosion resistance of gray iron. Its ability to bend and twist under extreme loads has enabled one State Highway Dept. to approve its installation directly under busy highways without the use of protective casings, and others are considering similar approval.

In addition to its practical application in highway construction, American Ductile Iron Pipe has many uses throughout the gas industry, for ocean-going tankers, in wells of all types, for many services in the petroleum and petro-chemical fields and in industry. —CE-3

Rapidograph Technical Fountain Pen

A SIGNIFICANT DEVELOPMENT IN its Rapidograph Technical Fountain Pen for drawing, ruling and lettering has been announced by Koh-I-Noor Pencil Company. The new model, No. 3065, makes available to draftsmen a single holder with seven interchangeable point sections that provide seven different line widths—00, 0, 1, 2, 2½, 3 and 4.

Seven Interchangeable Point Sections

Each point section has its own refillable translucent plastic ink cartridge. The entire set comes with a squeeze bottle dispenser for ink in a handy set box that serves as a permanent container for the holder and point sections. Each point section is numbered and "Color-Coded" for instant identification of line width.

Interchange of points is accomplished easily, in a matter of seconds, and in complete cleanliness—without danger of getting ink on fingers or work. Either India or regular writing ink can be used. —CE-4

First 50CM Radar Installation

JUST OFFICIALLY OPENED, Wellington Airport, New Zealand, is the first airport in the world to have a high-power (500kw) 50cm radar installation. Supplied and installed by Marconi's Wireless Telegraph Co. Ltd., the equipment is the Type S264A with a dual transmitter/receiver installation, either unit of which can be switched to a common radar aerial. Two-way microwave radio links are provided, over which the radar signals are passed to displays at the airport and the Airways Control Center four miles away; the links also provide a path for the remote control of the radar head.

The Civilian Aviation Administration (Air Dept.) of New Zealand, requiring a system which would provide both long-range airways cover and short-range airport approach control in a single piece of equipment, with the added requirement that its operation should be unaffected by heavy rainstorms, decided that the Marconi equipment best met these needs. —CE-5

Alphanumeric Typewriter

FULL AND DIRECT ALPHANUMERIC in output and control for the G-15 General Purpose Digital Computer is now available with the new G-15 Alphanumeric Typewriter, produced by Bendix Computer Division of Bendix Aviation Corporation.

The typewriter is fully alphanumeric because every character on the keyboard, upper and lower case alphabetic characters, numbers, symbols, and carriage controls, may be typed into and out of the computer.

The typewriter is directly alphanumeric because the user types exactly what he sees on the keyboard, just as in normal typing. No confusing two-number codes or time consuming subroutines are needed to accomplish alphanumeric input, as with most computers. —CE-6

New Epoxies Developed

DEVELOPMENT OF SIX NEW TYPES of Epoxy resins for use in building, construction and maintenance have been announced by Sika Chemical Corporation. The materials have undergone extensive testing in the laboratory and in the field for two years.

Formulated especially for the construction industry, the epoxy compounds include joint sealants, crack sealants, bonding compound, patching compound, skid-resistant surfacing for highways and corrosion resistant surfacing for concrete. The materials exhibit high bond to structural materials, stability over a wide range of temperatures, resistance to corrosions, compatibility to all concrete and masonry and rapid curing. When cured they will withstand temperatures up to 225 deg F, without impairing their physical properties. The epoxies are resistant to gasoline, oil, organic solvents, alkalies and most acids. —CE-7

SPECIAL!

ENGINEERS' INFORMATION SERVICE

As a further service to our readers we will periodically make available this new system which greatly simplifies the procedure for obtaining additional data on advertised products, new developments reported by manufacturers in "Equipment, Materials and Methods and Literature Available." Instead of writing separately to each manufacturer, you need only circle the items you would like to receive on the coupon printed below and mail it to:

ENGINEERS' INFORMATION SERVICE
CIVIL ENGINEERING
33 West 39th Street ▪ New York 18, New York

For information on products advertised in this issue, circle the appropriate page number on the left-hand coupon; for items listed in "Equipment, Materials and Methods and Literature Available," circle the appropriate key number listed on the right-hand coupon. In addition to your name and address, be sure to include your title and firm name on the coupon. All information will be sent directly to you from the manufacturers.

January, 1960—Products Advertised

ENGINEERS' INFORMATION SERVICE Date.....
CIVIL ENGINEERING
33 West 39th Street
New York 18, New York

PLEASE SEND me more complete engineering information on the products advertised in the pages circled below.

IFC	25	106	127
1	26, 27	107	128
2	28	108	129
6, 7	30	109	130
8	32	111	131
9	83	114L	132T
10, 11	85	114R	133TL
12	87	115	133BL
13	89	116	133R
14, 15	95	117	134L
16, 17	96	118	134TR
18	97	119	134BR
19	98	120	135
20, 21	99	121	IBC
22L	100	122	OBC
22R	101	123	
23T	102	124	
23B	103	125	
24	105R	126	

Note: The following code identifies the location of the ad when more than one advertisement appears on a page: T-top, B-bottom, L-left, R-right, IFC-inside front cover, IBC-inside back cover, OBC-outside back cover.

Name .....
Title .....
Company .....
Address .....
City, Zone and State .....

January, 1960—Equipment, Materials, Etc.

ENGINEERS' INFORMATION SERVICE Date.....
CIVIL ENGINEERING
33 West 39th Street
New York 18, New York

PLEASE SEND me more complete engineering information on the items featured below.

CE-1	CE-10	CE-19	CE-28	CE-37	CE-46	CE-55	CE-64
CE-2	CE-11	CE-20	CE-29	CE-38	CE-47	CE-56	CE-65
CE-3	CE-12	CE-21	CE-30	CE-39	CE-48	CE-57	CE-66
CE-4	CE-13	CE-22	CE-31	CE-40	CE-49	CE-58	
CE-5	CE-14	CE-23	CE-32	CE-41	CE-50	CE-59	
CE-6	CE-15	CE-24	CE-33	CE-42	CE-51	CE-60	
CE-7	CE-16	CE-25	CE-34	CE-43	CE-52	CE-61	
CE-8	CE-17	CE-26	CE-35	CE-44	CE-53	CE-62	
CE-9	CE-18	CE-27	CE-36	CE-45	CE-54	CE-63	

Note: Code number identifies location of item in Equipment, Materials and Methods and Literature Available Sections, starting on Page 112.

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Authoritative help for engineers

NONDESTRUCTIVE TESTING HANDBOOK

This new pioneering Handbook covers all the means of testing the essential properties and performance capabilities of materials, parts, components, and structures *without impairing serviceability.*

Explains and illustrates applications, advantages, limitations of 24 different test methods applicable in every branch of engineering and industry. Specifications, equipment costs, hundreds of pages of test interpretation data. *Prepared under the auspices of the Society for Nondestructive Testing. 1,100 illustrations, graphs, tables; 1,910 pp. 106 Contributing, Consulting Editors. Robert C. McMaster, Ed. October, 1959.* 2 volumes, $24

PRODUCTION HANDBOOK

Packed with practical production know-how, this Handbook is the complete key to management-engineering methods that are revolutionizing industrial production today. Fully covers new materials, machines, processes, and proper functioning of company organization.

Supplies proved principles, time- and work-saving systems, and successful operating procedures for maximum productivity at minimum cost. Saves hours of research and costly experimentation. *726 illustrations, tables; 1,726 pp. 48 Contributing, Consulting Editors. Gordon B. Carson, Ed. 2nd Ed., 1958.* $16

MATERIALS HANDLING HANDBOOK

The complete guide to modern materials handling. This unique Handbook explains the governing principles, today's most efficient methods and systems, and recommended equipment for moving material at least cost — whether in raw, in-process, or finished form.

Useful in all industrial situations, Handbook answers every basic question of work flow within and outside the plant. *Sponsored by The American Society of Mechanical Engineers and the American Material Handling Society. 991 illustrations, tables; 1,740 pp. 84 Contributing, Consulting Editors. Harold A. Bolz, Ed.; George E. Hagemann, Assoc. Ed. 1958.* $20

USE THIS COUPON TO ORDER HANDBOOKS OR FREE DESCRIPTIVE BROCHURE

Please send books checked below:

- ☐ **Nondestructive Testing Handbook,** McMaster, 2 vols. $24
- ☐ **Production Handbook,** 2nd Ed., Carson 16
- ☐ **Materials Handling Handbook,** Bolz-Hagemann 20
- ☐ **Please send free Descriptive Brochure on the above Handbooks.**

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EQUIPMENT MATERIALS and METHODS

(continued)

New Excavator

THREE OF THE TOUGHEST tunneling jobs in the country, Glen Canyon Dam, The Fort Pitt Tunnel, and The Mammoth Pool Diversion Tunnel, demanded a mucking machine that had the dependability, mobility, stamina and capacity required to meet deadlines. The Eimco 105 Excavator, manufactured by The Eimco Corporation, met all these requirements.

The design simplicity and rugged construction of 105 Excavators result in long-life dependability and stamina under the most gruelling job conditions. Independent track movement with fingertip control permits rapid spin-turns and maneuverability, cuts cycle time and makes the operator's job easier. This mobility feature is a big advantage in cramped quarters, narrow passages and extreme grades. Extra load capacity results due to the ability of the bucket drive assembly to make full use of engine horsepower, unique rocker arm contour and bucket design to get 39,000 lb of digging force at the lip. These features enable Eimco's 105 Excavator to produce high tonnage excavating at low operating and maintenance costs. —CE-8

Aluminum Chain Link Fence

FOUR MILES OF GLEAMING ALUMINUM chain link fence along the brand new 36th Street Causeway between Miami and Miami Beach highlight a pacesetting area use of aluminum road, bridge and electrical products by the Florida Road Department.

Said to be one of the longest aluminum chain link fences in the southeastern U. S., it joins a variety of other aluminum uses along the $14 million dollar causeway, according to Reynolds Metals Company, supplier of most of the aluminum for the project.

Engineers chose aluminum primarily because this is a highly corrosive salt water area and experience has shown aluminum requires little or no maintenance. Attractiveness was also a factor since many thousands of visitors will travel over this causeway from the Miami International Airport. Another important factor for selecting aluminum was saving in maintenance. —CE-9

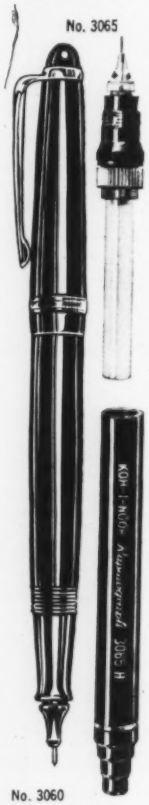
Soil Sampling Equipment

TWO PIECES OF SOIL SAMPLING equipment produced by Sprague & Henwood, Inc., include the Split Barrel Sampler and the Stationary Piston Type Sampler.

(Continued on page 116)

KOH-I-NOOR
PRECISION MATCHED INSTRUMENTS

Koh-I-Noor offers draftsmen an important new dimension in a comprehensive line of instruments and accessories meticulously matched to provide new high levels of professional performance, efficiency and convenience.



NOW...
TWO KOH-I-NOOR
RAPIDOGRAPH
TECHNICAL FOUNTAIN PENS

In 7 "color-coded" precision line widths: 00, 0, 1, 2, 2½, 3, 4. Uses India (or regular) ink for ruling, lettering, tracing or writing with equal facility.

MODEL NO. 3065: A new model with 7 interchangeable drawing point sections, each color-coded to indicate a different line width. Best buy for the professional who requires frequent change of line widths. Each drawing point section complete with airtight refillable ink cartridge. Interchange is accomplished quickly, cleanly. Comes in handy desk top container.

MODEL NO. 3060: The regular Koh-I-Noor Rapidograph "Technical" Fountain Pen with self-contained automatic filling system, and pocket clip is a standard drafting room tool.

Two Koh-I-Noor products designed to work together . . . for greater efficiency!

KOH-I-NOOR
ADAPTO-CLUTCH LEAD HOLDER
Non-slip, turn-proof clutch takes full range of Koh-I-Noor lead.

KOH-I-NOOR
EJECTOMATIC LEAD DISPENSER
Automatically feeds lead to holder without need to touch lead. Transparent container permits constant inventory check on lead supply. In 17 degrees. Widest choice of containers with 2, 6 and 12 leads.

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500,000-gallon Horton Waterspheroid serves the Martin Company, Orlando, Florida

■ Sound engineering . . . modern design . . . creative craftsmanship in steel . . . CB&I combines them all in the Waterspheroid. An extremely attractive, elevated water storage tank, the Waterspheroid compliments any architecture . . . blends with any landscape.

Chances are, you've seen a number of Waterspheroids. They landmark many of the world's most progressive plants and communities . . . providing dependable gravity water pressure for general service and fire protection. A brochure containing details and specifications is available. Write for your personal copy, today. No obligation, of course!

Send for your copy of the Watersphere and Waterspheroid brochure. Ask for Catalog A-40.

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CHICAGO 4, ILLINOIS

OFFICES AND SUBSIDIARIES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

The Split Barrel Sampler is a general all-purpose sampling device. The barrel is split longitudinally so that it can be taken apart and the sample examined in the state in which it was recovered from the ground.

The Stationary Piston Type Sampler is a thin wall tube sampler equipped with a piston assembly. The piston is held at the forward end of the tube until the depth is reached at which a sample is to be secured. Then the piston rod, which extends to the surface, is clamped firmly in place and the tube pressed or jacked under steady pressure past the piston into the soil to be sampled. —CE-10

Induction Heat Treatment Method

AFTER EXTENSIVE RESEARCH, an induction heat treatment method for stress-relieving strand for prestressed concrete has been perfected by Bethlehem Steel Co. The precise temperature control and other features of the induction heating produces a stress-relieved strand with uniform mechanical characteristics from reel to reel, as well as within the individual length contained on a reel.

The hard drawn high carbon wire used in the manufacture of stress-relieved strand tends to be very stiff and difficult to handle. The combination of performing the individual wires as they are stranded, and Bethlehem's unique method of stress-relieving yields a strand which permits ease of handling and is free from undue wildness.

Stress-relieving by the induction method is considered preferable to the more conventional methods by reason of the more accurate control features which were designed and incorporated into this process. Furthermore, such stress-relieved strand produced by this method is cleaner and presents a surface which will readily bond with the concrete. —CE-11

Direct Reading Level Rod

A DIRECT READING LEVEL rod is available from Lenker Manufacturing Company, which eliminates all computations. For engineers, contractors and builders, the L-E-Vation Rod is made of maple in two sections for extension. It is 1¾ square, 5.4. ft folded and 10 ft extended. The face section carries a graduated, endless, 10-ft steel band which runs over end rollers to bring any reading into view. Back section carries a clamp for holding the rod in extension and a latch for locking the band in any required position. —CE-12

Compression Machine for Small Specimens

A NEW MODEL M-100 Compression Machine designed specifically for testing small specimens such as 2-in. x 2-in. cubes and 2.8-in. x 5.6-in soil cement cylinders in compression has been announced by Forney's Inc., Tester Division.

Weighing approximately 125 lb, it is readily portable, and has a loading capacity from 0 to 60,000 lb. A variety of 8-in. diameter gages equipped with instant snap-on connectors are calibrated in ranges from 0 to 3,000 lb with 10-lb increments. Spherically seated upper platen assemblies for cubes and cylinders are made in accordance with ASTM specifications, and can be interchanged easily without tools. —CE-13

ZF PREFABRICATED PUMPING STATIONS

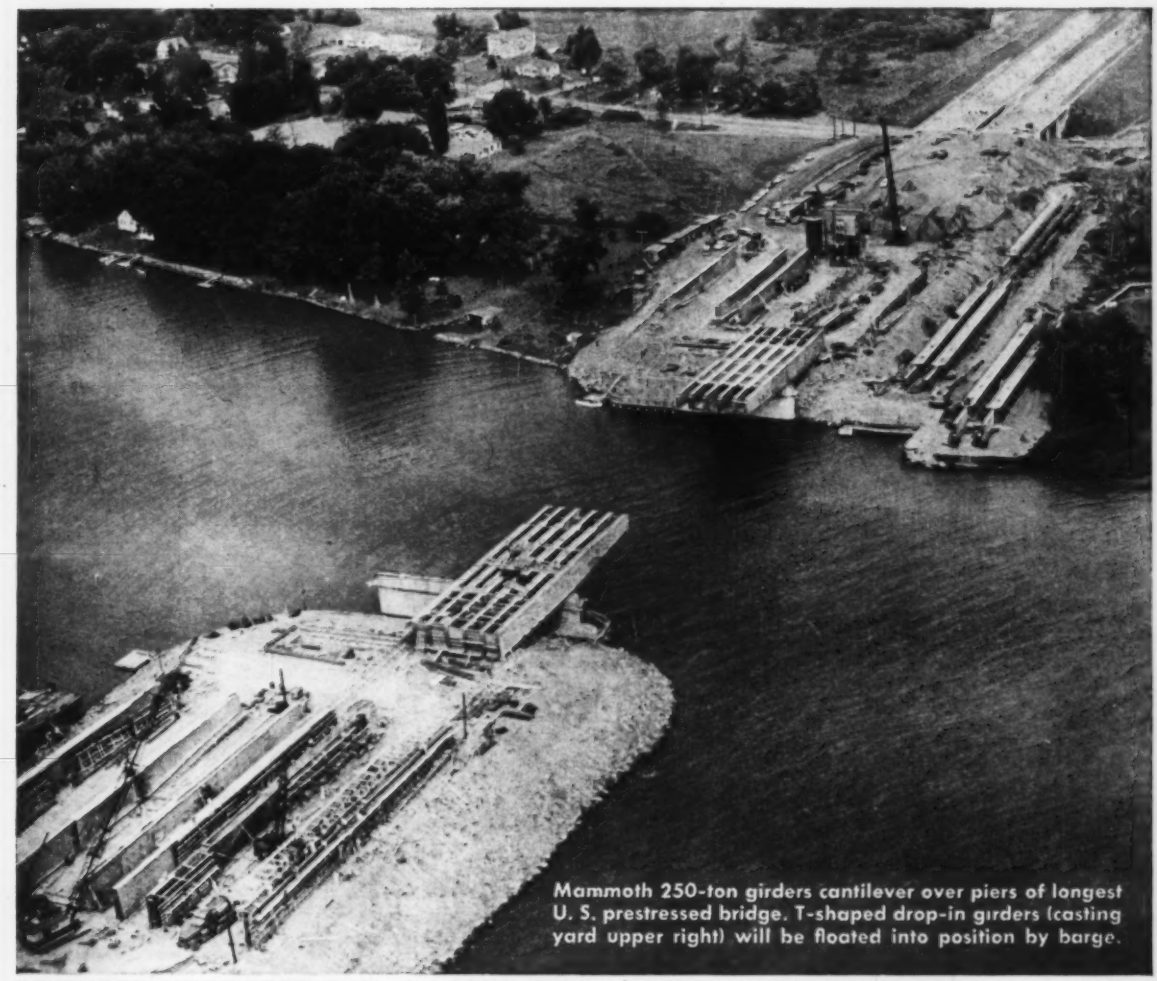
A PACKAGED UNIT—completely shop-fitted with quality components throughout. Transported to job site ready for installation.

SIMPLIFIES LOCATION—underground operation permits use of existing public property such as parkways, etc. Saves cost of surface property and enclosing structure.

ECONOMICAL—saves costs and time. Prefabrication results in lower construction costs and less time at job site. Simply set in place, connect and start up.

COMPLETE DATA, SPECIFICATIONS AND DRAWINGS AVAILABLE—WRITE

ZF ZIMMER & FRANCESCON P.O. BOX 359, MOLINE, ILLINOIS



Mammoth 250-ton girders cantilever over piers of longest U. S. prestressed bridge. T-shaped drop-in girders (casting yard upper right) will be floated into position by barge.

NEW YORK STATE DEPT. PUBLIC WORKS, Owner / TERRY CONTRACTING CORP., General Cont.

Controlled Quality with PLASTIMENT

Oneida Lake Bridge, longest prestressed bridge in the nation spans 320-ft. from pier to pier. The structure consists of twenty-four 147-ft. girders weighing 250 tons each which cantilever 72 feet over shore side piers and ten 222-ton drop-in girders 231 feet long. All girders were precast and prestressed in three job site casting beds.

PLASTIMENT was specified for its proven ability to facilitate placement of the concrete in hard-to-get-at sections of the 14-ft. high forms; speed strength development (4,000 psi in five days without steam curing) permitting early stripping of forms and early stressing; control the quality of the concrete with varying temperatures. Quantities of **PLASTIMENT** were varied according to manufacturer's specifications to assure uniformity under varying temperature conditions.

PLASTIMENT features are detailed in Bulletin PCD-59. Contact your Sika distributor for your copy. District offices and dealers in principal cities; affiliate manufacturing companies around the world.

Sika®

SIKA CHEMICAL CORPORATION

Passaic, N. J.

(continued)

Portable Moisture Meter

EXACT MOISTURE CONTENT of sand, soil or any bulk material is measured instantly, automatically by a new portable moisture meter manufactured by C & W Sales Co. This lightweight electronic instrument avoids costly delays and equipment downtime by taking the guess-work out of moisture content. Slung over the shoulder, it measures instantly and accurately the exact moisture content of surface or sub-surface sand, soil or any bulk material. Moisture content registers on the dial when the probe, connected by insulated cord to the meter, is plunged into the material. —CE-14

Rubber Seat Butterfly Valve

THE MONOFLANGE MARK 11, a rubber seat butterfly valve designed to mount between pipe flanges, is offered by Henry Pratt Company. Some of the features of the valve include leakproof packing, nylon bearings, straight through shafts and hycar seat.

Chevron packing is used; no adjustments are necessary. Increases in line pressure automatically increase sealing pressure, yet packing will not bind or gall shaft. In a prototype, under actual working conditions, nylon bearings were tested through 100,000 cycles, with negligible wear. No lubrication is necessary. All Monoflange Mark 11 shafts are one piece, through shafts—conservatively sized to resist 150 psi pressure across the closed disc. —CE-15

High-Tensile Bolt

A NEW TYPE HIGH-TENSILE Structural Rib Bolt with rolled interrupted ribs, said to give a high clamping force and a body-bound fit in a structural joint, is available from Automatic Nut Company.

According to the manufacturer, the bolt is designed with the proper length of rib for the thickness of the plates, thus preventing the riding of any steel on the bolt threads. The full thickness of the plates is in full bearing at all times.

The flat head of the bolt and the taper at the start of the ribs permit easy driving. The bolt can be driven in misaligned holes with a 3-lb hammer or can be pulled in with the nut. —CE-16

Rubber Waterstop

A NEW RUBBER WATERSTOP that can be spliced in just 6 minutes has been introduced by the Gates Rubber Co. With this new product, called Gates Kwik-Seal Rubber Waterstop, strong, permanent splices can be made 5 times faster than with former methods.

Instead of requiring heat-sealing or vulcanization, the new Kwik-Seal splice is chemically bonded. Only a small splicing kit and a simple clamping device are

Chemically Bonded

needed—no heat is required, no vulcanizers, no molded parts. Both the waterstop and the splice meet or exceed government requirements.

Kwik-Seal rubber Waterstop retains a watertight seal even when movement occurs in a concrete joint. It is used to prevent seepage and leakage wherever concrete is used: dams, power stations, pumping and water stations, canals, reservoirs, tanks, wall base joints, bridge abutments, building foundation walls and swimming pools. —CE-17

Vertical Short Coupled Service Pumps

VERTICAL SHORT COUPLED SERVICE PUMPS, used by industries which require booster and service pumps, by oil refineries, pipe lines, municipal and private waterworks systems and wherever liquids are to be pumped, are available from Layne & Bowler, Inc. The applications include pumping from river or lake, line boost-

(Continued on page 120)

EVER SEE A CONTINUOUS TRULY UNDISTURBED SOIL SAMPLE 15, 30 OR EVEN UP TO 60 FEET IN LENGTH

In addition to being able to secure conventional type soil samples, Sprague & Henwood, Inc., also has available the Swedish Soil Sampler to recover undisturbed samples 15, 30 or even up to 60 feet in length. With this device, slide resistance and wall friction are almost eliminated and thin critical layers of soil that usually go unnoticed are easily detected.

Let us help you in solving your foundation testing problems. We have the equipment, personnel, and drilling "know-how" necessary to undertake your particular project. Our complete drilling service is illustrated and described in the new S&H Contract Brochure, write for your copy today.

A Sprague & Henwood crew recovering a 30 foot sample of sensitive marine clay.

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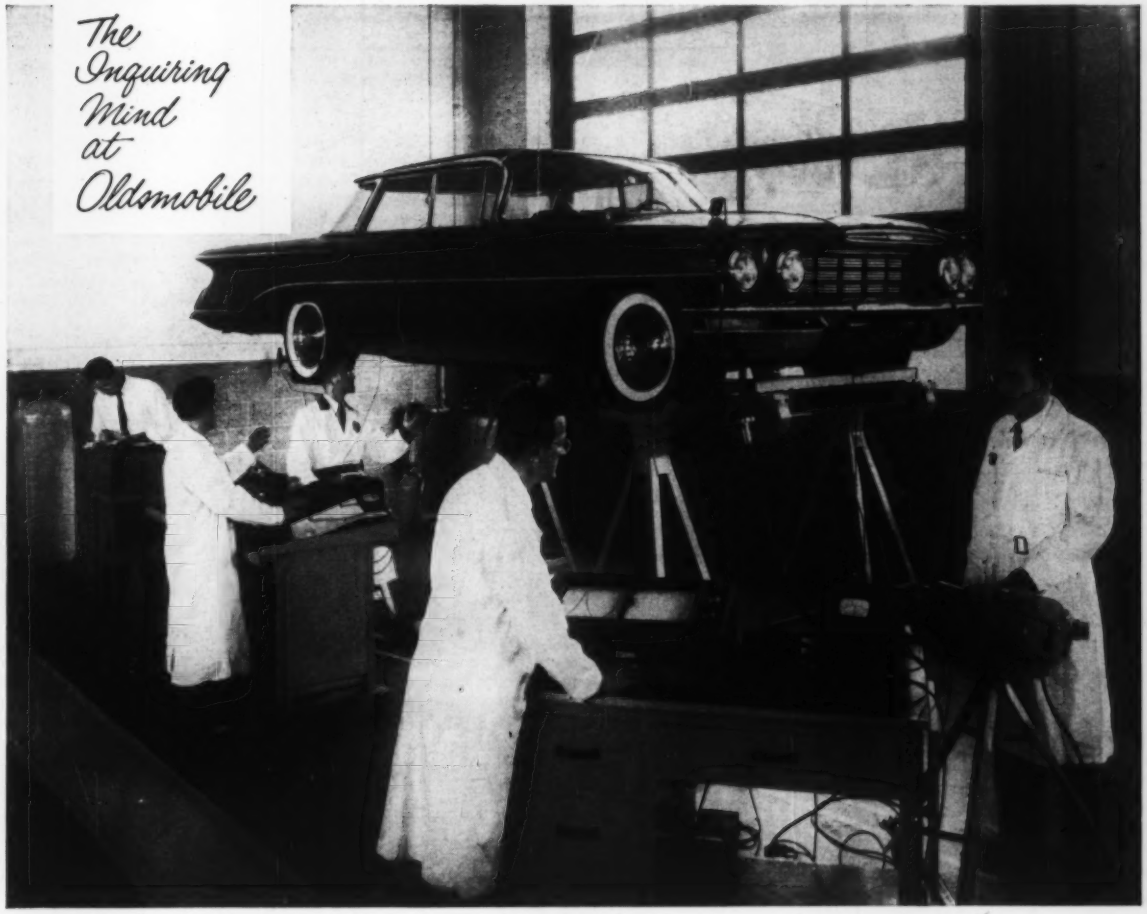
New York—Philadelphia—Atlanta—Pittsburgh—Grand Junction, Colo.—Buchans, Nfld.

The Inquiring Mind at Oldsmobile



no. 10 OF A SERIES

IT'S THE QUIETEST RIDE YOU'VE EVER TRIED!

New Vibra-Tuned Body Mountings—electronically located at the nodal points of the frame by Oldsmobile engineers—produce an exceptionally quiet and satisfying ride.

Quietness in a fine automobile is a mark of superior quality. To make the 1960 Oldsmobile the quietest, most comfortable car on the road, Oldsmobile engineers have developed many advanced testing techniques to insulate against all types of road noise.

One of the unique ways in which noise and vibration are isolated by Oldsmobile engineers is through Vibra-Tuned body mountings. These mountings—direct attaching points between the body and frame—are critical to comfort and to the life of the car. If they are not properly placed, severe road vibrations can literally shake the car apart in a few thousand miles. But, by using the most advanced electronic measuring techniques, a softer and quieter ride is achieved by placing the body mounts at the nodal points of the frame. In this way, inherent road vibrations and shocks are practically isolated from the passenger compartment.

In the "tuning" of the chassis and body, the car is subjected to severe shaking, at a frequency of 7½ to 15 cycles per second, by a mechanical oscillator to produce torsional and bending moments. By using numerous electronic pick-ups, movement of the frame and body at a given point can be determined quickly and translated into an accurate magnitude vs. frequency curve through an X-Y plotter. By a complete and thorough examination of the entire car in such a manner, it can be determined where the "dead" or nodal points are on the frame, and the body mounts can then be scientifically placed. Then, after being located, the hysteresis characteristics of the body mounts are determined to give the most satisfying ride.

These methods, and many more up-to-the-minute techniques, have enabled Oldsmobile engineers to build consistently fine quality automobiles year after year. Visit your local authorized Quality Dealer and drive a 1960 Oldsmobile. See why it's the most satisfying car you've ever known . . . *the finest the medium-price class has to offer!*

OLDSMOBILE DIVISION • GENERAL MOTORS CORPORATION

OLDSMOBILE **Where Proven Quality Is Standard!**

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...AND THE WORLD OVER
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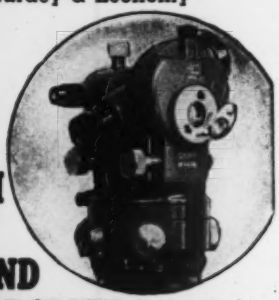
SURVEYING INSTRUMENTS
*The Bridge Division of the State of Texas Highway Dept. uses Kern Instruments
WORLD FAMOUS FOR
Working Speed
Operational Simplicity
Accuracy & Economy

DKMI TEN SECOND THEODOLITE (with optical micrometer)
- Exceptional portability and precision.
- Readings automatically ... AT A GLANCE.
- Direct reading to 10". Estimation to 1". Average working accuracy —3-4 secs.
- Can be used with electric lighting unit for night work.
KERN CENTERING TRIPOD
Unique—a Kern first! Centers instruments in seconds with remarkable accuracy. Assures exceptional stability with ball-and-socket head, supporting instrument coupling.

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FACTORY TRAINED PERSONNEL
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The FINEST in SURVEYING EQUIPMENT
KERN INSTRUMENTS INC.
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EQUIPMENT, MATERIALS and METHODS

(continued)

ing, recirculating, air conditioning, high pressure pumping, cooling condensers or diesel engine jackets, process pumping, pit, sump or caisson drainage, fire pumping service and dewatering. —CE-18

Blue Line Diazo Paper

A NEW FAST BLUE LINE, standard weight diazo paper called Super-Speed Blue Line 200SS is now being marketed by the Ozalid Division of General Aniline and Film Corporation. It is designed as a production booster on machines having low-powered ultra-violet light sources or operations using originals that are old, yellowed or of low-translucency. Especially suited for general industry, engineering departments, oil companies, utilities and in government, the 200SS has a high speed, blue line diazo coating with good line density on a 20½ white base sheet.

The 200SS will increase production from sepia intermediates; both new sepias and old sepias which may have developed background with aging. Using the 200SS will increase production from low-translucency originals such as heavy, translucent card stock. —CE-19

Irrigation Pipe

ECONOMICAL, DEPENDABLE IRRIGATION is made easy with permanently trouble-free asbestos-cement underground irrigation pipe, manufactured by Keasbey & Mattison. Advantages offered by asbestos-cement pipe include the unique K&M Fluid-Tite coupling which is easy to assemble and provides a permanently tight seal. —CE-20

Steel Rail Pipe Cuts Cost

A NEW TYPE FOUNDATION pile made from three steel rail sections welded along their base edges saved two months time and $10,000 over caissons on the construction of a bank building in Pueblo, Colo. Fabricated by the Houston Division of L. B. Foster Company, the pile drove easily through tough soil filled with boulders, and permitted Hutcheson Construction Co., Englewood, Colo., to drive 83 piles 20-32 ft long through a boulder filled site and get out in only four days.

The rail piles were driven with a Link-Belt 12K diesel hammer riding in 62-ft long leads hung from a Manitowoc 2000 crane. A conventional follower block was used between hammer and pile, with the addition of a short shaft welded to the block which projected into the core of the rail pile to keep the block centered.

The rail pile in cross section is a hollow equilateral triangle with rail heads extending outward 120 degrees, which takes advantage of the high tensile, yield and compressive strengths of rail steel. The shape gives the piles a general symmetrical section so that its section modulus is approximately the same around any axis, providing high resistance to forces from any direction. —CE-21

New Writing Tools

NEW WRITING INSTRUMENTS especially designed for the age of office automation are being marketed by the Eberhard Faber Pencil Company. Both special pencils and ball pens are being made available not only for the new office reproduction devices, but also for the electronic data-processing cards. Some make markings that are electrical conductors, where required.

Several of the new writing instruments are designed for use with a wide variety of the brand-named duplicating and copying machines. Eberhard Faber is also expanding production of the special writing instruments as it has been making for the standard gelatin and spirit duplicator processes.

The new line has 11 pencils and five ball pens of various colors and writing densities, including the Blak-Print and Fotorite pens, and Litho-Print, Fotorite and Contak pencils. Another pencil, the No-print, is designed for marginal notations and instructions, which are not intended to be reproduced by a photo-copying machine. —CE-22

Builders Hand Level

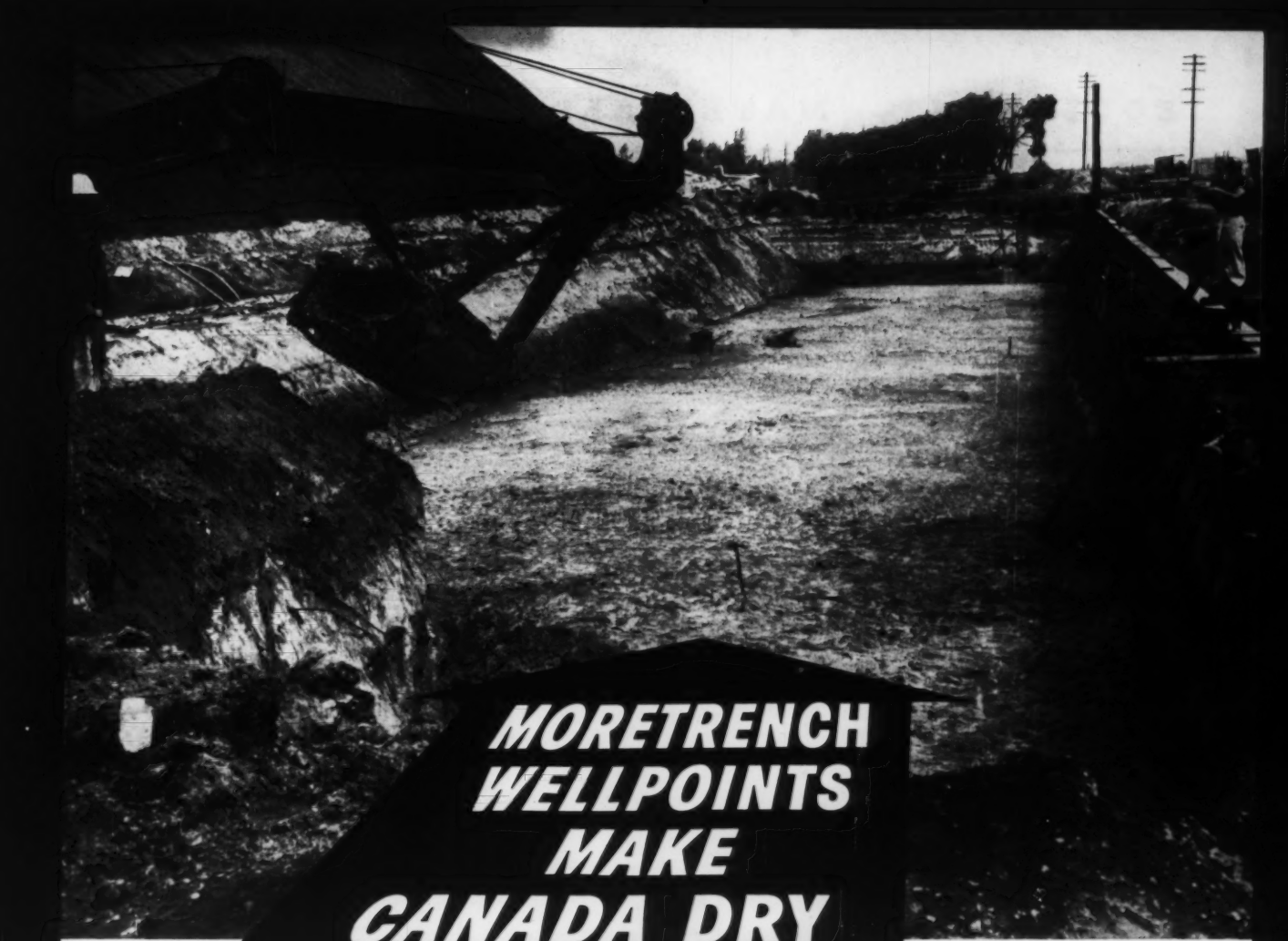
INTENDED FOR USE BY BUILDER, homeowner, contour farmer, road grader and others requiring approximate elevations, a new Hand Level has been produced by Eugene Dietzgen Co. The level vial is completely protected; cross hairs and stadia lines are registered permanently on object glass—stadia is standard 1:12. Built-in sunshade reduces eye strain. Extremely versatile, it can also double as carpenter's level; the bottom edge is straight edge and bubble registers level. A handy spring tension clip secures instrument to pocket or belt. —CE-23

Optical Plummet

AN OPTICAL PLUMMET which enables a Transit man to set up much faster and more accurately, without using a Plumb Bob than with a Plumb Bob, is available from Warren-Knight Co. The Tele-Plumb can, however, be used with or without the Bob.

The Tele-Plumb is exclusive in that it

(Continued on page 122)



MORETRENCH WELLPOINTS MAKE CANADA DRY

Engineers: Stone & Wubster Canada, Limited

In this neat, deep, DRY foundation — 300′ away from Lake Ontario — go the 90″ reinforced concrete pipes which return water to Lake Ontario after it has passed through the condensers in the new extension to Ontario Hydro's Richard L. Hearn Generating Station.

Ground level is 252, water table 246, subgrade 236. Material — sand pumped in from the lake.

(Note the thousands of tons of coal stockpiled close to the excavated area, giving further evidence of soil stability.)

"Much of our success on this project is attributable to the excellent ground conditions created by Moretrench equipment," says John Famigletti, president of Atlas Excavators, Ltd., Toronto contractors for the excavation and installation of the pipe.

When your problem is water, call us. We can help!

Photo courtesy Ontario Hydro Photography Section, Graphic Dept., Information Division.

MORETRENCH Corporation

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WESTERN REPRESENTATIVE: Andrews Machinery of Washington, Inc., Seattle 4, Washington
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BRAZILIAN REPRESENTATIVE: Oscar Taves & Co., Ltd., Rio de Janeiro

(continued)

is fitted and fastened to the objective end of the Transit Telescope and a sight to a point beneath, or above, the instrument is made through the main Transit Telescope with the full 25 power of the telescope.

The Transit with Tele-Plumb attached can be stored in the regular carrying case or the Tele-Plumb may be removed and stored in the case. —CE-24

Form-Crete Steel Forms

FORM-CRETE STEEL FORMS, designed for use on flat casting beds, have been made available by Food Machinery & Chemical Corporation. They are supplied in desired lengths of up to 30 ft which facilitates economical shipping and fast, easy installation and handling.

Form-Crete forms are manufactured to close tolerances in order to give the precise castings necessary in the prestressed concrete field. The use of 7 gauge steel in the construction of the forms produces rugged forms that ensure this precision throughout a long life. —CE-25

Concrete Saws and Blades

A PROMINENT ROLE is played by Clipper Concrete Saws and Blades in the construction of a 3½-mile segment of Interstate Highway 35, near Claycomo, Mo. Manufactured by Clipper Manufacturing Co., the 36-hp Concrete Saws Model C-363 are sawing all control joints, both longitudinal and transverse, in the 24-ft wide, 8-in. thick concrete slab. The 3½-mile segment will enable highway traffic

Playing Prominent Role

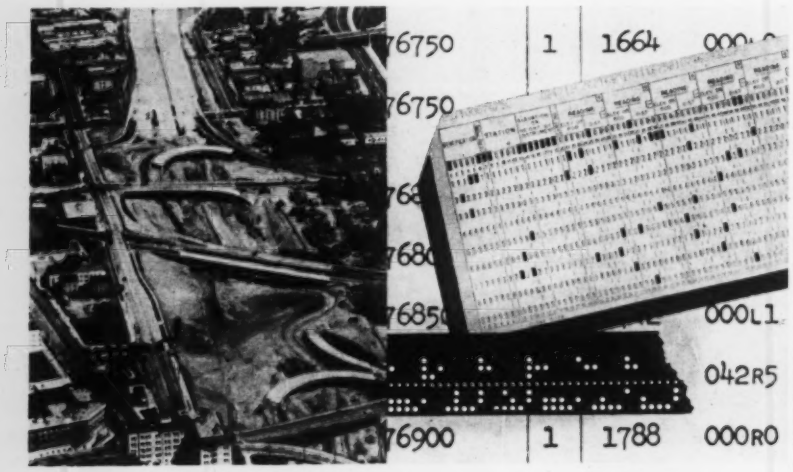
to by-pass Claycomo, a suburb of Kansas City, with a resultant faster flow of traffic.

The J. A. Tobin Construction Co. of Kansas City, Kansas, is using Clipper Green Con reinforced abrasive blades for sawing the new concrete and Clipper's Hot Pour Joint Sealer Model AC-40A to seal all the control joints. The AC-40A seals up to four miles of joints per day and combines the melting and pressure sealing unit in one compact kettle. —CE-26

Dredging Equipment

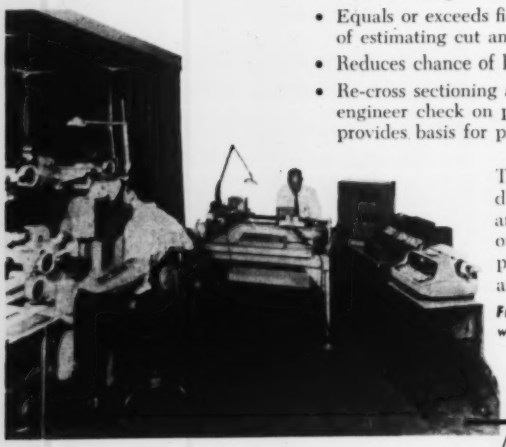
SOME OF THE DREDGING EQUIPMENT available from Posey Iron Works, Inc., includes drag heads, combination wye branch and gate valve, fabricated spuds, pontoon and shore pipe, pressed steel plate ball joints with abrasion resisting steel plate liners, and hydraulic dredge hull. The company offers a complete selection of pipe and other dredge fittings

(Continued on page 124)



New Fairchild Service provides cross section and profile data in DIGITAL FORM *automatically!*

- Saves time and money in highway and railroad location design and construction.
- Equals or exceeds field accuracy of estimating cut and fill.
- Reduces chance of human error.
- Re-cross sectioning at periodic intervals gives engineer check on progress of earthmoving; provides basis for paying contractor.



The recorded terrain output data is automatically typed and simultaneously produced on punched cards. Punched paper tape output is also available.

Free brochure! Phone, wire or write your nearest Fairchild office.

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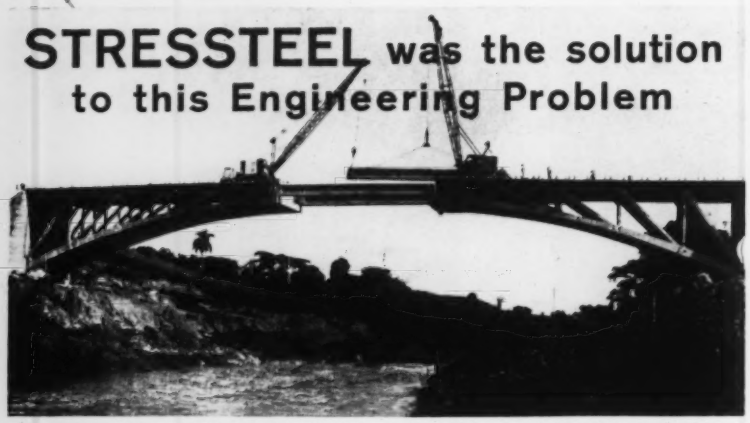
MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND

M.2A

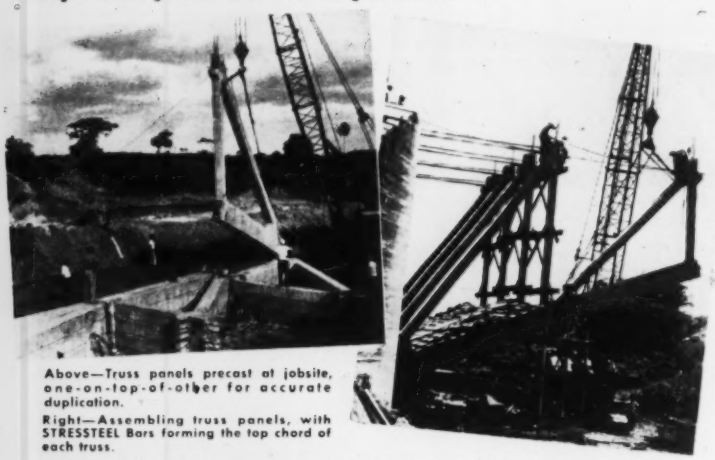
STRESSTEEL was the solution to this Engineering Problem



Zaza River Bridge—Comision de Fomento Nacional, Cuba. This unique bridge, just completed in Las Villas, for the first time uses precast and post-tensioned concrete to form cantilever trusses. Mario G. Suarez—Arango y Salas, Designers and Engineers. Cia. Territorial y Constructora Celo S. A., Contractor.

THE PROBLEM: How to prestress and assemble precast sections for a 300' cantilever concrete truss bridge with maximum efficiency and minimum cost.

THE SOLUTION: First, use STRESSTEEL Bars to post-tension the vertical legs of each precast panel. Next, use STRESSTEEL Bars to form the top chord of each panel and hold the truss together during erection and pouring of bridge deck. Finally, with additional STRESSTEEL Bars, post-tension the entire assembly of panels through the bridge deck to form an integrated truss.



Above—Truss panels precast at jobsite, one-on-top-of-other for accurate duplication.

Right—Assembling truss panels, with STRESSTEEL Bars forming the top chord of each truss.

Imaginative engineers now recognize that the use of light, precast concrete trusses for bridges and buildings offers a new and unexplored field in concrete technology. Rigid STRESSTEEL Bars, easily placed, connected and tensioned are ideal for these applications. These high strength bars are available in sizes from ¾" ∅ to 1¼" ∅ with recommended working stress for prestressing up to 90,000 psi. Equipped with wedge or threaded anchors, they offer effective solution to the special anchoring problems of precast units.

You will achieve superior results at substantial savings with STRESSTEEL because it is . . .

- High strength alloy steel
- Low in labor cost
- Low in initial cost
- Easy to tension

Are you working on an application combining precast concrete with post-tensioned prestressing? STRESSTEEL may well be the optimum solution. Ask us.

Member—Prestressed Concrete Institute

STRESSTEEL CORPORATION

221 Conyngham Ave. • Wilkes-Barre, Pa.

Sales Offices: Minneapolis — San Francisco — Havana

EQUIPMENT MATERIALS and METHODS

(continued)

to meet every dredging need. All units that are subject to abrasion are fabricated from high carbon—high manganese special dredge pipe steel or abrasion resisting steel. —CE-27

Floating Digesters and Settling Tanks

FOUR DIGESTERS MEASURING 100 ft in dia by 30 ft 4 in. high and six settling tanks 122 ft in dia by 13 ft 1 in. high, all of prestressed concrete construction, are now being erected at the Metropolitan Syracuse Treatment Plant of the Onondaga Public Works Commission, Onondaga County, N. Y. The walls of the settling tanks and digesters and the concrete domes of the digesters are being constructed by Preload Concrete Structures.

One of the major reasons for constructing the digesters of prestressed concrete is to reduce loadings on the soil, since the digesters will more or less float in the muck prevalent in the valley area contiguous to Syracuse, N. Y.

Digester concrete base slabs are 3-ft thick while the settling tank slabs vary from 5 ft at the center to 2 ft 6 in. at the edge. The walls of the digesters are of 8 in. thick poured concrete whereas those of the settling tanks are of 5-in. thick pneumatically applied mortar. The settling tanks are open vessels but the digesters are covered. —CE-28

Clad Steel Bridge Bearing Plates

STAINLESS-CLAD STEEL, a material long used by the process industries for its corrosion-resistant properties, has lately been employed in a variety of applications in the bridge construction market, according to Lukens Steel Company. Most recently, clad steel has been specified for the bearing plates on the Throg's Neck Bridge and for expansion joint members on the new level of the George Washington Bridge. Citing reasons for the use of clad steel, bridge designers point out the corrosion-resistant surface of the material which prevents the possibility of bearing rollers or rockers "freezing" to the plates (and thereby denying free movement to the bridge). Also, clad steel costs considerably less than solid stainless, the alternative corrosion-resistant material.

Clad steel is composed of a layer of stainless steel integrally bonded to a rugged yet inexpensive backing steel. This factor, of course, accounts for its relatively low cost as compared to solid stainless. Clad steel can be supplied with a variety of cladding surfaces, but stainless Types 410 and 304 seem best suited for bearing plate applications. —CE-29

Top performance, high efficiency and less maintenance are factors which influence the selection of a short coupled pump. Layne Vertical Service Pumps fulfill these requirements and offer the advantages of lower installation and operation costs, low submergence requirements, simple alignment, no priming and less floor space demands. For any short coupled pumping job . . . specify Layne.

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SALES REPRESENTATIVES IN MAJOR CITIES

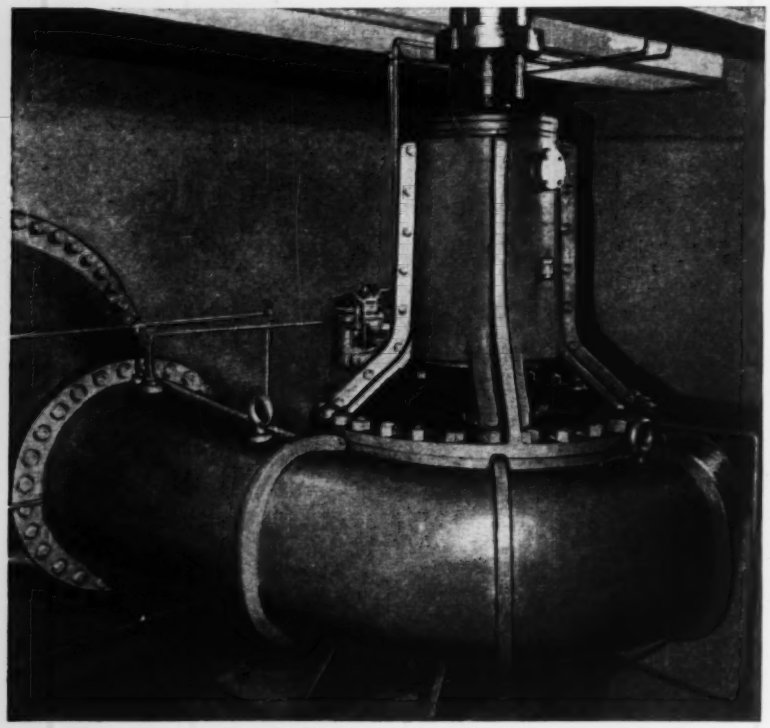
Heavy-Duty Trucks

A NEW 230 SERIES OF off-highway heavy-duty International trucks with choice of gasoline, LPG or diesel powered engines has been introduced by the motor truck division of International Harvester Company. The new series, which includes six basic models in both four-wheel and six-wheel design, offers gross vehicle weight ratings ranging from 46,000 to 73,000 lb.

Design features include diamond plate steel fenders, heavy-duty brush guard, double-channel heat-treated frame, two new rear axles and a broad selection of heavy-duty optional components.

Engine availabilities for both four-wheel or six-wheel models are the International Red Diamond 501 six rated at 212 hp, International V-549 V-8 rated at 257 hp, and Cummins NH, HR and NT series diesels. Both six-cylinder and V-8 powerplants are offered with factory-installed LPG fuel systems.

New rear axle on the standard 230 four-wheel model is rated at 35,000 lb. Its features include a cast steel housing, high torque capacity planetary double-reduction differential carrier, induction-hardened axle shafts and forced flow lubrication that insures an adequate supply of lubricant to all working parts of the axle within one-half revolution of the wheels. —CE-30



the bigger your pumping problems... the better your reasons for giving them to **WHEELER-ECONOMY**

The entire C. H. Wheeler organization is geared to the design, development and production of high-capacity pumps.

Pumps like the one you see here, for example—one of three 36" x 30" Vertical Mixed Flow Volute Units installed at the Wapato Irrigation Project, State of Washington. These Pumps handle larger volumes at lower first cost than any other kind of pumping equipment!

Wheeler-Economy Axial and Mixed Flow Pumps range in capacity from 5,000 to well over 220,000 gpm; in head from five to 75 ft. See your W-E representative or write direct for the pumps you need, *specifically designed for your application.*

Economy Pump Division

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Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Centrifugal, Axial and Mixed Flow Pumps • Steam Condensers • Steam Jet Vacuum Equipment • Marine Auxiliary Machinery • Nuclear Products

Infrared Sensing Device

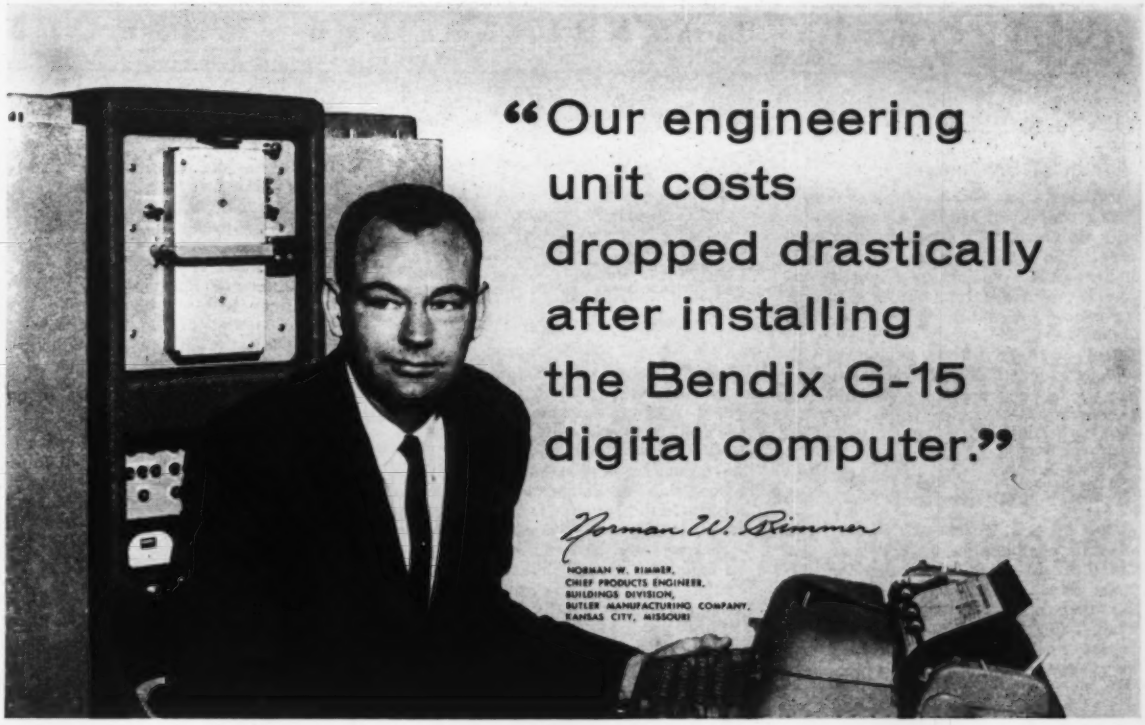
A DETECTOR THAT SENSES the presence of "invisible light" has been produced by Eastman Kodak Co. It forms the heart of two new instruments developed for U.S. Weather Bureau aid to air navigation.

Known as the Kodak Ektron Detector, the infrared sensing device is an essential part of a new cloud-height indicator and of transmissometer that determines the amount of water vapor in the air. The Cloud-Height indicator, made by Radio Receptor Corp., sends up a rotating beam of infrared radiation. At one angle of rotation, maximum radiation is reflected from the base of the cloud formation and picked up by a detector stationed a known distance from the projector.

The angle between the cloud-scanning beam and the horizon is read from an indicator that shows at what point in the beam's rotation, maximum infrared energy was received. This angle, plus the distance between projector and detector, enables scientists to calculate cloud-base height through triangulation. —CE-31

Ruling Pen

MARATHON PENS OFFER A distinct advantage over ordinary ruling pens by drawing from five to eight times more inches of line per filling, according to Keuffel & Esser Co. For example, No. 9 width pens will rule about 45 ft of line in contrast to ordinary pens, which rule about 6 ft of same width line. The pens may be laid down on the drawing even with ink in them; the ink will not run out. The Marathon pens need no setting for line widths. Three fixed widths of nib are accurately pre-set. —CE-32


"Our engineering unit costs dropped drastically after installing the Bendix G-15 digital computer."
Norman W. Rimmer
NORMAN W. RIMMER,
CHIEF PRODUCTS ENGINEER,
BUILDINGS DIVISION,
BUTLER MANUFACTURING COMPANY,
KANSAS CITY, MISSOURI

Butler's progressive engineering program requires a fast, versatile, and low-cost computer. It must handle complex structural problems and still be simple enough to be used by engineers with no programming experience. The computer's mission: cut engineering unit costs. *"Our own survey proved that the Bendix G-15 digital computer could best do this job,"* says Mr. Rimmer, *"and it does."*

For Butler, part of the cost-cutting versatility of the G-15 stems from the variety of programming methods they can use. For the solution of repetitive problems at highest speeds, they use the machine language system. With the simplified Intercom 1000 system, the entire staff uses the computer for structural design problems. This versatility also means the G-15 can be used for business data processing as well as scientific and design calculations.

Butler is also pleased with the expandability of the G-15. They know that as their computing requirements grow, they can add magnetic tape units, punched card equipment, digital differential analyzers, plotters, and other accessories. Remember, however, that the basic G-15, which includes a unique photo-electric tape reader-punch and alphanumeric typewriter, is more than adequate for most problems.

Find out more about this computer — the *only* medium-scale computer in the low-price field. Inquiries regarding specific applications are welcomed.

Bendix Computer

DIVISION OF BENDIX AVIATION CORPORATION

DEPT. P-16

LOS ANGELES 45, CALIFORNIA

Slurry Seal

BITUMULS SLURRY SEAL, an operation which consists of mixing the aggregates with Bitumuls and water to a slurry consistency in a transit mixer, and spreading over the pavement by a special constructed squeegee type spreader box, is announced by American Bitumuls and Asphalt Co. The action of the squeegee forces the slurry into the fine cracks of a weathered but still sound surface of an old asphalt pavement, thereby reducing expensive maintenance patch construction to a minimum. —CE-33

Finisher-Float

AN ALL-NEW MODEL Flex-Plane gas-electric combination finisher-float machine which assures contractors the ultimate in superior concrete slab finishes has been manufactured by the Heltzel Steel Form & Iron Co. By utilizing two separate gas-electric drives, Heltzel engineers have achieved a smoother power flow with infinite speed ranges both to the drive wheels and screeds. Thus the

Smoother Power Flow

rate of machine travel does not affect screed operation.

The finishing machine section can be used independently providing contractors with utmost flexibility. The self-contained finisher section can be quickly detached and used independently; its frame adjusts from 12 ft to 26 ft to handle single lanes, double lanes, ramps or approaches.

This new unit has been thoroughly tested under all paving conditions. Previous models have finished in excess of 5,000 ft in a 12 hour day. —CE-34

Surveying Instruments

A NEW LINE OF surveying transits and levels are now being distributed in the United States and possessions by Charles Bruning Manufacturing Company, Inc. The Path line includes 4-in and 6-in transits, transit levels, dumpy levels, eye levels, tilting levels and pocket levels.

The instruments use Japanese lenses, recognized as among the finest in the field. These lenses provide superior definition of viewed objects; distinct, powerful magnification of images, and resolute, unwavering accuracy on targets. Built to withstand temperature extremes and rugged field conditions, Path instruments are manufactured under exacting standards of assembly, adjusting and testing.

For protection during transport, transits and levels are securely fastened to the floor of sturdy wood carrying cases. Instrument adjustment tools, a plumb bob, magnifying glass and sunshade are standard equipment, and are firmly fixed in carrying case brackets. —CE-35

Lightweight Steel Forms

EASY TO HANDLE AND designed for accurate concrete placement and reusability, lightweight steel forms manufactured by Blaw-Knox Company, helped speed construction of more than 42,000 feet of curb and gutter in a new residential area in Birmingham, Ala.

David N. Nichols, concrete foreman for Meadow Corp., general contractor for the 269-home Chapel Hill subdivision, said his crew was able to set up the forms three times faster than other units considered for the same application. One thousand feet of the steel forms were employed in concreting all straightaway curb and gutter.

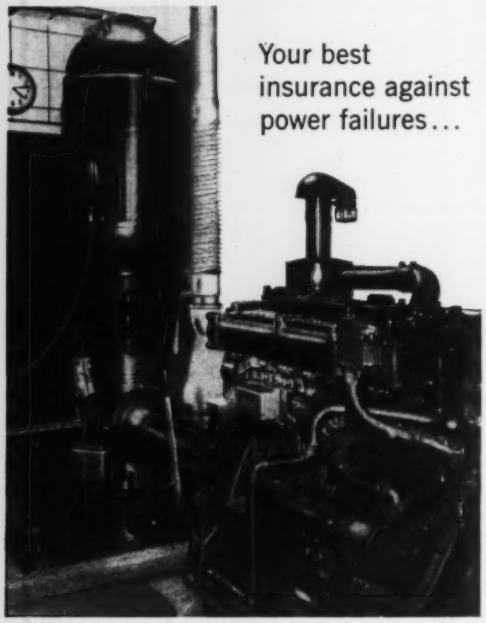
Two types of curb and gutter were constructed, depending on the grade. Twelve per cent grade was the determining factor in use of valley type or curb type gutter. Six-inch high forms were used to construct valley gutter, 30-in. wide and including a 2-in. center depression. Valley gutter was placed on all level ground and on slopes where incline was less than 12%. On steeper grades, the contractor used curb with a 12-in. high back and the 6-in. high steel forms as facing. The contract called for placing concrete in 42,240 ft of curb and gutter. —CE-36

Building Sheet

A MAJOR NEW PRODUCT development, aimed at accelerating construction uses of aluminum by both the industrial and residential building industries, was announced by Aluminum Company of America.

The innovation is Alcoa Building Sheet, a completely new standard item now being marketed in coils or flat sheet

(Continued on page 129)



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GEAR DRIVES

With the Johnson Combination Drive shown here, either the vertical electric motor or horizontal engine can be used to drive your pump. Engine takes over if power fails; makes continuous supply of water available for domestic, industrial, or fire fighting use. Thousands in use.

Sizes: 15 to 500 hp. for all horizontal prime movers and any vertical shaft pump. Combination, dual, and standard types; hollow or solid shafts. Write now for engineering catalogs.

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12-R

EQUIPMENT MATERIALS and METHODS

(continued)

at prices competitive with galvanized steel and kindred major building materials. It is said that the new product is being fabricated from one alloy, especially developed and tested by Alcoa Research Laboratories for this purpose. The single Alclad alloy will replace a host of other sheet alloys previously employed in the building product line. The Alclad process, also a product of Alcoa research, metallurgically bonds corrosion-resistant aluminum alloys to a structurally stronger base alloy.

Besides establishing a new standard in its field, Alcoa Building Sheet will possess higher strength than most alloys currently employed for building products, the company stated. —CE-37

Extruded Aluminum Diving Boards

THE DURA-FLEX extruded aluminum diving board has been made available by National Pool Equipment Co. This completely engineered product, so designed as to give a nearly perfect curve from tip to anchor, is extruded with the top surface skin and specially designed ribs, all in one piece. The taper then provides the uniform, soft flexing action, affording maximum spring and gives performance unequalled in the field.

Manufactured to Army-Navy Aircraft riveting specifications, these boards have been tested both statically and dynamically. When used on standard fulcrums, they will take no permanent set when static loaded with 1200 lb. When used on a standard fulcrum, the 16-ft board static loaded with 1200 lb, has a tip deflection of 30 in; this exceeds that of any other diving board and is double that of the average board, according to the company. —CE-38

New Computer

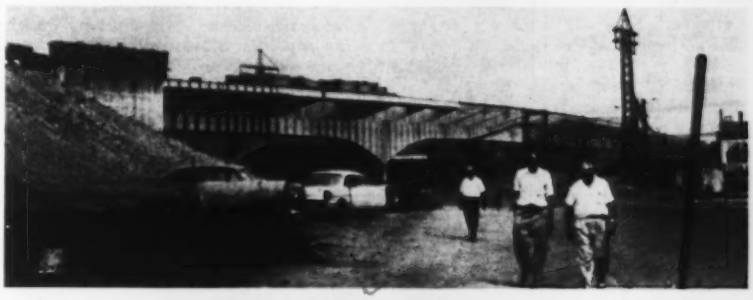
THE MICROLOG SERIES 2 computer, expressly designed to meet the requirements of a successful training instrument for students of analog computer applications and techniques, is offered by Ebex Sales Incorporated.

Suitable for both classroom and individual study use, this light portable machine sets the standard in the field of instruction by leading the student into an active role in the learning process.

Providing facilities for programming studies ranging from simple arithmetic through advanced calculus and differential equations, it is suitable for use by management and research in connection with computer feasibility studies.

(Continued on page 130)

New Haven Bridge Project



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Designed by D. B. Steinman

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Owner; State of Connecticut

The New Haven bridge provides overhead crossing of the New York, New Haven and Hartford Railroad in New Haven, Conn. Just completed in November, 1959, it has the longest box girder spans in the world.

Again U.S.F. steel forms were depended upon in utilizing the newest in safe, time-saving and money-saving methods. We'll send full details.

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Highway Guard Rail • Bridge Flooring
Steel Forms for Concrete Bridge Decks
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(continued)

The computer may also be used by engineers for simulation of processes, thus eliminating the need for expensive miniature models. In solving dynamic equations the process may be observed as it varies with time to show the exact step through which the answer moved.—CE-39

Fuel Cell-Powered Tractor

A NEW SOURCE OF electrical power—fuel cells—has come out of the laboratory to power a vehicle for the first time. The fuel cell-powered tractor, manufactured by Allis-Chalmers Manufacturing Co., develops at least 3,000 lb of drawbar pull. Although the experimental fuel cell tractor is of commercial size, it is still a research vehicle.

The electricity that drives the tractor comes from 1,008 individual fuel cells, which are joined in 112 units of nine cells each. The 112 units are arranged in four banks and electricity can be taken from any combination of the banks. A mixture of gases, largely propane, fuels the cells. The gases are fed into the cells through a system of tubing and, once in the cells, the gases react in an electrolyte. A catalyst coating the electrodes of each cell aids the reaction.

The chemical reactions within the cells cause a direct current to flow through an external circuit which is connected by bus bar to a standard controller. The compact controller, measuring 8 by 11 by 21 in., regulates the electricity supplied to a standard 20-hp DC motor made at Allis-Chalmers Norwood (Ohio) Works. —CE-40

New Weigher Uses T-1 Steel

A NEW, HIGHLY MOBILE bulk material weigher capable of spewing six tons of gravel from hopper to truck in ten seconds is helping contractors speed America's interstate highway program in the West. It is the "Schrock Speed-Weigh" developed by the Western Conveyor Co., Boise, Idaho, which has eliminated costly truck tie-up time at loading and weighing points on a Morrison-Knudsen interstate highway project at Morgan, Utah.

The Speed-Weigh owes its mobility and durability to United States Steel Corporation's T-1 constructional alloy steel. By using T-1 steel for hopper and gate liners, they were able to cut the weight in half and increase service life of these parts by 65%.

USS T-1 steel is a low carbon, quenched and tempered alloy steel formulated to withstand shock loading and severe impact abrasion. It lasts three times longer and is three times stronger than the equivalent carbon steel.

—CE-41

Hand Level

A NEW, VERSATILE AND dependable pocket-size engineering hand level is now being manufactured and distributed by Leupold & Stevens Instruments, Inc. The Leupold Hand Level is designed for preliminary survey work in building, excavating, road construction and farm use.

Versatile and Dependable

A draw-focus eye piece gives extra long sighting plane for more accurate leveling and magnifies the bubble level image. Inner surface of the tube is coated to eliminate distracting reflections. This sturdy, lightweight and compact instrument measures only 5½ in. in length with eyepiece retracted and is ⅞ in. dia. It is furnished with a heavy duty saddle leather case which has handy belt loop.

—CE-42

Small Plant Sewage Treatment

FOUR UNITS, CLARIGESTER, DEGRITTING Clarigester, Duo-Clarigester and CompleTreator, are designed to provide big plant operation on a small plant scale. Manufactured by Dorr-Oliver Incorporated, each is capable of a high degree of treatment and three of the four provide treatment steps in addition to those of primary clarification and sludge digestion.

The Clarigester is the basic unit from which the other three have been developed. Comprising a mechanically equipped clarification compartment mounted above a digester, the unit has proven easy to operate and control as well as economical.

Incorporating a means of positive grit removal in the clarification chamber, the Degritting Clarigester provides an answer to the age-old small sewage treatment plant problem of grit control. In this unit, an annular channel surrounding the influent well contains sufficient area to allow all plus 65 mesh to settle out prior to clarification. —CE-43

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MANUAL VALVE ACTUATORS
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Corrugated Metal Structures

A LOW-COST, PRACTICAL WAY to obtain underground passageways is offered by Armco Drainage & Metal Products, Inc. through easy-to-install Armco Corrugated Metal Structures.

Contractors and gravel companies are making wide use of Armco Tunnels in efficient handling of aggregate. These tunnels are economical, easily erected and can be disassembled, moved to a new location then quickly reassembled.

When pipe lines or cables pass between buildings or under embankments they can be kept open to inspection and repair by encasing them in an Armco Service Tunnel. Service lines can then be inspected at will and there is no need to rip out costly surface installations when repairs are necessary. In addition, an Armco Service Tunnel protects utility lines from the weight of high fills and the impact and vibration of heavy traffic. —CE-44

Power Shift Transmissions

POWER SHIFT TRANSMISSIONS, each of which features an exclusive new concept in the transmittal of tractor power, are now available from Caterpillar Tractor Co. for the Caterpillar D8 and D9 Tractors. Providing instantaneous, one-lever control of gear shifting without interruption of power and momentum, they are built to withstand the demanding conditions of tractor service.

By a unique utilization of planetary gear versatility, introduced to the industry on these machines, tractor performance is provided which combines the best features of both direct drive and torque converter power trains. Heart of the new power-tailoring arrangement is a planetary gear set, driven integrally by the engine flywheel, which transmits ⅓ of the engine torque directly to the transmission input shaft, and the remaining engine torque through the torque converter. Horsepower of both machines has been increased to give an additional boost to productivity. —CE-45

Welded and Fitted Railings

WELDED RAILINGS OFFERING the designer virtually unlimited architectural flexibility for even the most complex configuration provide the ultimate in strength and practical utility and give beauty through selection of various materials or specially shaped sections, according to the manufacturer, Tubular Products, Inc.

Welded railings are normally manufactured from standard and extra-heavy iron pipe sizes in either steel or aluminum. Seamless or electric resistance welded tubing and special extruded or formed shapes (round, square, rectangular, oval, etc.) can also be used individually, or in combination, to provide dramatic architectural treatment—economically.

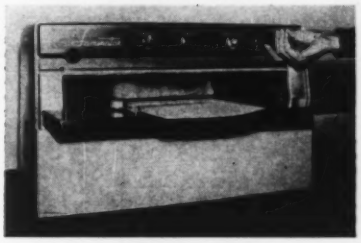
Tubular welded railing requires the minimum of field labor—all railings are shipped in convenient lengths completely pre-assembled and finished to your specifications. To meet individual needs these fabricated units can be designed for a variety of field connections; welded, threaded, slip fit, locking section, etc.

Fitted railings in aluminum or steel with threaded or slip fit connectors can be pre-cut in the plant and shipped completely knocked down, or either partially or fully assembled within the limits of shippable sizes. —CE-46

Auto-Therm Laminator

A NEW INSTANT LAMINATOR with a greater range of precise speed and heat control, enabling it to seal paper, chipboard, cover stock and most originals in any type of film or acetate, has been announced by General Binding Corporation.

Known as the Auto-Therm Laminator, Model 1-17-D, the machine has a controllable thermo-dial heat range of +120 deg to +380 deg F, and a variable processing speed, ranging from 12 to 25 ft per minute. It is designed to encase valuable papers, drawings or photographs in a thin, pliable film which acts as a tough, invisible protector against stains, grease, acids and rough handling.



Model 1-17-D

Special polyester film commercially available can be laminated at the exact fusing point by regulating the machine's exclusive thermo-dial. Equal and continual distribution of heat is assured by three thermostats.

Independent of the heat dial, the laminator's speed control makes it possible to seal all originals regardless of thickness. This means that by operating the machine at slow speeds, extra-thick originals will be exposed longer to heat, assuring a secure film fusing. —CE-47

Transistorized Scientific Computer

A SMALL, TRANSISTORIZED, scientific computer which can perform more than 100,000 calculations a minute has been announced by the Data Processing Division of International Business Machines Corporation.

The new IBM 1620 Data Processing System operates under the direction of an internally stored program of instructions, and it can perform complex engineering and scientific computations on a continuous basis. The 1620 is particularly adaptable to problems such as highway cut-and-fill and bridge design, oil pipeline transmission and product inventory, petroleum blend evaluation, lens design, and power requirements analysis for utilities.

Advanced features incorporated in this compact but powerful computer include 20,000 digits of magnetic core storage with variable field length and immediate accessibility, and paper tape and electric typewriter input and output. —CE-48

CONCRETE TESTERS

The World's Finest Low-Cost Precision Testers For

CYLINDERS
CUBES
BLOCKS
BEAMS
PIPE

IF IT'S A CONCRETE TESTER YOU NEED-GET IN TOUCH WITH

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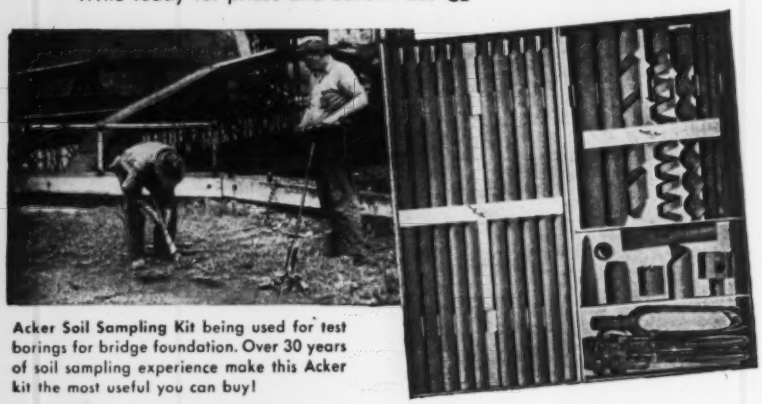
use an ACKER SOIL SAMPLING KIT for accurate sub-surface information

With accurate sub-soil information, you avoid costly trouble later on. And, what better way to get this information than with a portable, easy to use Acker Soil Sampling Kit. For here is a versatile collection of twelve soil sampling tools packed in a handy steel kit that can be carried in any car.

Write today for prices and Bulletin 26. CE



Acker Soil Sampling Kit being used for test borings for bridge foundation. Over 30 years of soil sampling experience make this Acker kit the most useful you can buy!

ACKER DRILL CO., Inc. P.O Box 830 Scranton, Penna.

Information received before March 15, 1960, will appear in the 1960 Directory

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Street

City Zone State

Send Mail and Publications to: ☐ Business Address ☐ Residence Address

Nature of Firm's Business
Product, Business or Service (Not for Publication)

Signature Date

EQUIPMENT MATERIALS and METHODS

(continued)

Concrete Testing Machine

A NEW 250,000-LB CONCRETE TESTING machine has been produced by Soiltest, Inc. Meeting ASTM and AASHO specifications for hydraulic concrete testing machines, this machine can be used for testing in the field, in concrete plants or in the laboratory. Entirely self contained, the machine requires no electrical or pressure connections. The weight is only 480 lb. Loads are quickly attained by easy hand operation. The dial gauge has a maximum load pointer and has large black figures for easy direct readings.

The hydraulic loading head threads into the top casting. Four steel uprights allow for the maximum of daylight opening in the testing frame, giving easy access to the specimen on all sides. The frame is finished in a grey enamel. The base has four holes for mounting or holding accessory equipment. The top plate has two handles for carrying or moving into the upper frame section and is easily removable for cleaning or maintenance. The piston is lapped and ground and all pressure seals are maintained by an "O" ring arrangement. —CE-49

New Tips Aid in Pile Driving

A NEW CONCEPT IN pile tips which will immeasurably aid in the driving of all types of piles in construction work, has been developed by Foundation Specialties, Inc. The new pile tips will prevent "hung-up" piles, collapse and distortion, bending or dog-legging, and clogging. The patented tips are available for use on closed-end piles, open-end piles, and H-beam bearing piles.

The Fin Tip is a steel casting in the form of an inverted cone having on its circumference integrally cast wedge-shaped fin-like blades, extending below the vortex of the cone, which act as a drill to penetrate heavy layers of coarse sand, hardpan or decomposed rock. The fins will not slide off but imbed themselves in sloping rock.

The Fin Tip for open-end piles is a steel casting in the form of two crossed blades at right angles to each other with cutting ends tapering inwardly. It is for use in areas where sloping rock is a major problem, as the tip will readily seat itself in the rock preventing dog-legged piles.

The Ram Tip is a steel casting in the form of two blades at right angles to each other forming a wedge-shaped cross at the base of the driving tip. The wedge-shaped blades disperse large boulders preventing them from lodging within the pile, allowing pile to cut through dense materials. —CE-50

New book tells

Where . . .

How . . .

to place reinforcing bars

Written for bar setters and inspectors . . . as a manual for apprentice courses . . . and a reference for specification writers, architects, engineers, and detailers.

Contains complete specifications and instructions for placing reinforcing bars, welded wire fabric, and their supports.

Prepared under the direction of the C.R.S.I. Committee on Engineering Practice.

287 PAGES—6" x 9" HANDY POCKET SIZE

$3.00

No C.O.D. orders accepted. Refund if returned within 10 days

Concrete Reinforcing Steel Institute
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Chicago 3, Illinois

NEW! EFCO BRIDGE COLUMN FORMS

EFCO Bridge Column Forms used on New Orleans overpass save time and labor. Precision construction permits quick, easy stripping as shown. Adaptable to a wide range of uses. Ideal for forming pier nosings when combined with regular EFCO Forms.

MAIL COUPON TODAY

Economy Forms Corp.
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Des Moines, Iowa

Please send information on EFCO Bridge Column Forms, and address of nearest sales office.

Name.....

Firm name.....

Address.....

City.....State.....

Literature Available

FACTORY-BUILT SEWAGE LIFT STATION—This 100-page engineering data manual on factory-built sewage pumping stations and pneumatic ejector lift stations, published by Smith & Loveless, Division-Union Tank Car Company, includes a new 8-page color bulletin describing the operation, design features and advantages of factory-built sewage pump stations. —CE-51

FOUNDATION CAISSONS AND PILES—An interesting, informative and well-illustrated brochure, made available by Franki Foundation Co., describes in detail the Franki method of installing Displacement Caissons and Pressure Injected Footings. Caisson load test results on representative projects and reinforced concrete cap design data are noted. —CE-52

STEEL LINER PLATES—Bulletin 300-C2, twenty pages of technical information on steel liner plates for excavation support in tunnel and shaft construction, is being offered by Commercial Shearing & Stamping Company. Furnishing engineering properties of tunnel liner plates, the brochure includes tables of suggested thicknesses of plates for a variety of uses; a table of permissible safe loads on circular tunnels of various diameters of arch. —CE-53

LIFTING INSERTS—A new 24-page Data Book on Lifting Inserts is available from Richmond Screw Anchor Co., Inc. This book covers the latest Richmond items for lifting prestressed and precast concrete members and also includes technical data on the application and placing of those inserts in concrete. —CE-54

LONG SPAN STEEL PIPE—A 12-page booklet showing details and installation pictures of Long Span Steel Pipe is available from Thompson Pipe & Steel Company. Long Span Steel Pipe eliminates highway hazards and costly structures. It crosses streams, highways and arroyos without obstructing piers or trestles and solves flood problems. —CE-55

BRIDGES—A fully illustrated color brochure is now available from The Ingalls Iron Works Co. The booklet features steel bridges fabricated by Ingalls Iron Works Co. and, in instances, erected by Ingalls Steel Construction Company. —CE-56

WELLPOINTS—A 4-page bulletin illustrating and describing standard and special types of Moretrench Wellpoints and their use in various types of jobs has been made available by Moretrench Corporation. —CE-57

WATER, SEWAGE AND WASTE TREATMENT—A complete line of equipment for the treatment of municipal and industrial water, sewage and wastes is presented in Walker Process Equipment Company's 24-page brochure, G50. Illustrations and brief descriptions of units for the major treatment processes are included.—CE-58

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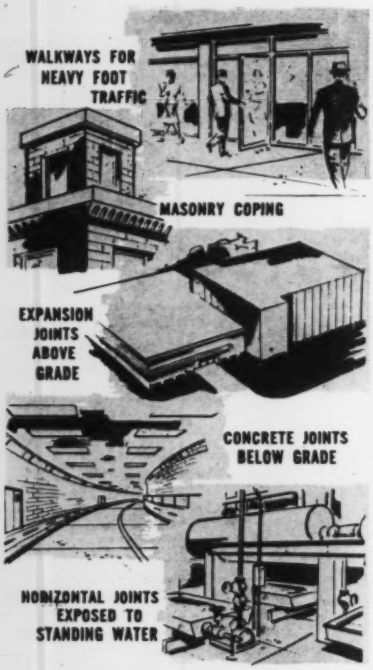
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Literature Available

PILE REPAIR–An 8-page illustrated booklet describing the "Dri-Por" system of pile repair and encasement applied to bridges and piers is offered by Masonry Resurfacing & Construction Co., Inc. The brochure describes several interesting applications of the "Dri-Por" system. —CE-59

STEEL GRID BRIDGE DECKING—A new 12-page colored catalog describing steel mesh bridge flooring has been published by Irving Subway Grating Co., Inc. It includes information on economy and safety features, tractional surfaces, tables of dimensions, loads and spans for longitudinal and transverse installations. —CE-60

THE PRESCON SYSTEM—A new two-color folder, No. 7, explaining the advantages of prestressed poured-in-place concrete tensioned by The Prescon System of post-tensioning in modern construction has been published by The Prescon Corporation. —CE-61

HEAVY CONSTRUCTION HANDBOOK—Free descriptive literature describing the Handbook of Heavy Construction by Frank Stubbs Jr. has been published by McGraw-Hill Book Co., Inc. The 1040-page Handbook contains working information needed in all branches of heavy construction. —CE-62

NEW HANDBOOKS—A descriptive brochure on three companion Handbooks giving complete guidance for solving problems of modern engineering and industrial operations is now available from The Ronald Press Company. The Handbooks are Production Handbook, Materials Handling Handbook, and Nondestructive Testing Handbook. Each is in the big 6 x 9 format. —CE-63

GK O LEVEL–Tiny newcomer to the level family already has many friends in the construction field. The GK O Level, manufactured by Kern Instruments Inc., allows rapid leveling conveniently and simply with Kern Jointed Head System. An article by P. Kern of Kern & Co., Ltd., Aarua, Switzerland, discusses in detail this reliable and sturdy instrument of compact design and small weight. —CE-64

STREET LIGHTING—A catalog on steel and aluminum street highway lighting standards, traffic signal standards and overhead sign structures is available from Kerrigan Iron Works Company. It contains engineering data on poles, brackets and mast arms, modifications and accessories, tests and chart data. —CE-65

EARTHWORK QUANTITIES—A brochure describing the latest equipment used for reading and recording cross sections and profiles for highway and other projects where earthwork quantities are involved has been made available by Fairchild Aerial Surveys, Inc. —CE-66

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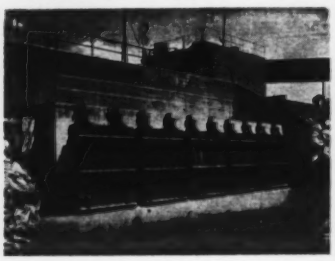

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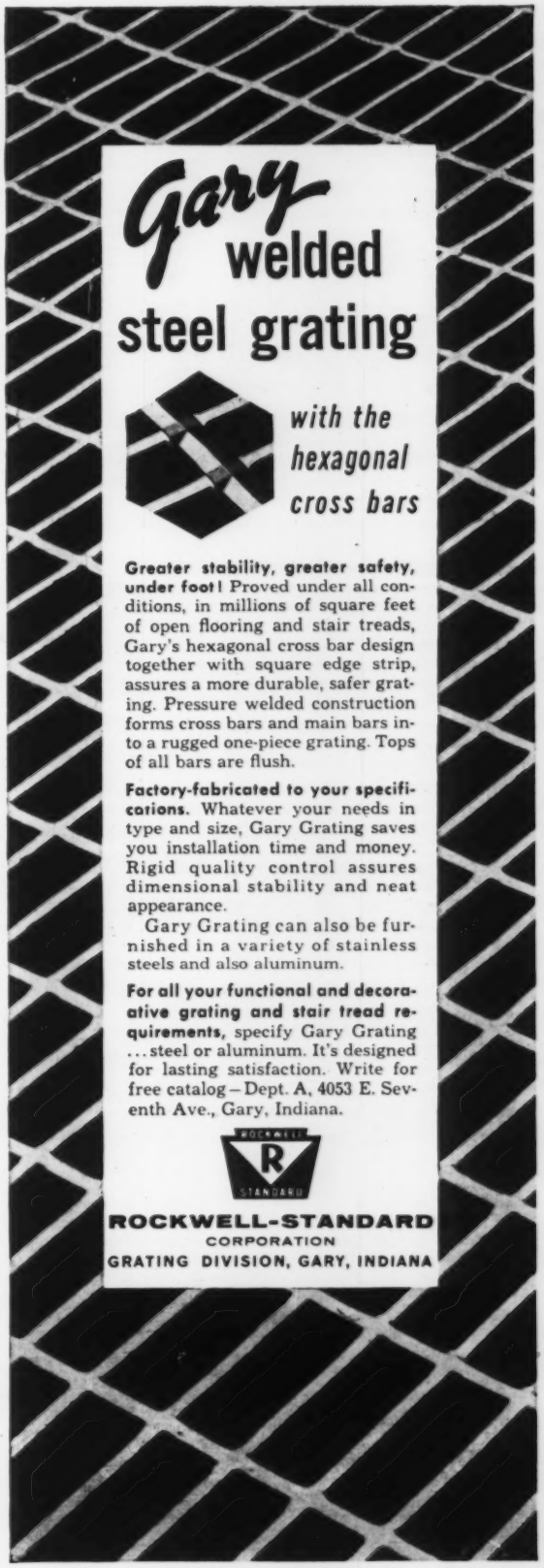
RECEIVE CONTRACT: Diversified Builders, Inc., subsidiary of Macco Corp., both of Paramount, Calif., and Fisher Construction Company of Houston, Texas, jointly received a contract to construct a new multi-million dollar Federal building in Houston, Texas, as announced by the General Services Administration in a recent release from Washington, D. C. . . . **OPENS SALES OFFICE:** Merrick Scale Manufacturing Co., one of the nation's oldest builders of continuous conveyor weighing and proportioning equipment, has factory representation at 400 West Madison St., Chicago . . . **MANUFACTURING RIGHTS GRANTED:** Napco Industries, Inc. has announced that it has granted manufacturing and sales rights for its four wheel drive, four wheel steer tractor to Cranes and Shovels, Pty., Ltd. of Melbourne, Australia . . . **NEW PLANT CONSTRUCTION:** Construction is to begin immediately on a styrene plant for C.S.R.C.-Dow Pty. Ltd. at Altona, Australia. George Wimpey and Coy Ltd., a firm with offices in London, England and Sidney, Australia, has been awarded the contract to build facilities in association with the Bechtel Corp. of San Francisco and McDonald Constructions Pty. Ltd. of Sydney . . . Construction of the Westinghouse Electric Corporation's new multi-million dollar power transformer plant in Muncie, Ind., has begun. The T-shaped plant will occupy over 600,000 sq ft of floor space and will be located on a 300-acre site south of Muncie . . . **RETIREMENT ANNOUNCED:** Mr. E. Roy Russell has retired as President of the Florence Pipe Foundry and Machine Company and of the R. D. Wood Company . . . **NEW DISTRIBUTION PROGRAM:** A new distribution program for Galv-Weld Alloy whereby independent distributors will be appointed throughout the country has been announced by Morton L. Clark, originator of the process of regalvanizing the otherwise corrosive seams and areas where galvanizing is burned away by welding, skipped in hot dip galvanizing, or abraded or chipped in fabrication . . . **OFFICE RELOCATED:** The Tulsa, Oklahoma district sales office of The Babcock & Wilcox Company's Tubular Products division has been moved to Suite 305, the Shell Bldg., 1810 South Baltimore, Tulsa 19, it has been announced . . . **PURCHASE ANNOUNCED:** Purchase of a 30-acre industrial site in Leesburg, Fla., for the construction of a plastic pipe plant, is announced by Thomas J. Evans III, president of the Evanite Plastic Co., a subsidiary of the Evans Pipe Co., Uhrichsville, Ohio . . . **RCA TO SERVICE VICTOREEN EQUIPMENT:** The Victoreen Instrument Co., manufacturer of radiation monitoring and other electronic equipment has announced it is augmenting its factory and field servicing through an agreement with RCA Service Co., a division of Radio Corporation of America. Under the agreement, the RCA Service Co. will provide installation, repair and maintenance and such other services as may be required in connection with portable and permanently installed Victoreen Equipment . . . **NEW ACQUISITIONS:** Extensive manufacturing facilities have been leased by General Kinetics Corp. in Englewood, New Jersey, where the new firm will manufacture ball valves and related products. It was stated that the new plant will triple capacity to produce P-K Paul valves, for which the firm recently acquired patent licenses . . . As another step in the Western expansion of H. K. Porter Co., Inc., diversified Pittsburgh, Pa. industrial concern, Porter has acquired Hill Transformer Corp., San Carlos, Calif. . . . Union Tank Car Co., Chicago, has acquired Smith & Loveless, Inc., Kansas City, manufacturer of factory-built sewage pumping stations and sewage treatment plants. The purchase was effective December 1 with Smith & Loveless, Inc. becoming a division of Union Tank Car Co. . . . **NEW PLASTICS PLANT:** Reynolds Metals Company's new plastics plant has swung into full-stream production of plastic films for a variety of uses ranging from children's kites to water-soluble plastic packets . . . **APPOINTMENTS:** Robert F. Goodney, former supervisor of sales for Darworth, Inc., manufacturer of wood preservatives and building specialties, has been appointed regional manager of a new technical promotion field office which was opened Nov. 1 by the National Lumber Manufacturers Association in Dallas, Texas.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PROCEEDINGS AVAILABLE

December

Journals: City Planning, Highways, Irrigation and Drainage, Power, Soil Mechanics, Structural, Waterways and Harbors, Hydraulics.

2271. Discussion Of Proceedings Paper 1902, 1996, 2018, 2020, 2022, 2056, 2058, 2085, 2149. (HY) John B. Lockett closure to 1902. John P. Herak and Salvador Rodriguez on 1996. J. Van Malde and E. V. Richardson on 2020. G. T. Berry, G. B. Fenwick and F. R. Brown on 2022. C. Biemond on 2056. J. R. Bowman on 2058. F. F. Escoffier on 2085. Byron N. Aldridge, T. R. Anand on 2149.

2272. Trends in Public Transit Improvement Programs, by W. S. Rainville, Jr. (CP) This paper describes recent trends in public transit improvement programs, classifying them into appropriate groupings and giving specific examples of each type of improvement.

2273. Characteristics of Traffic Flow on Freeways, by Adolph D. May, Jr. (HW) Traffic flow characteristics were studied on two high density controlled access facilities in Detroit, Michigan. Average speeds and volumes were recorded on a per minute, per lane basis.

2274. Engineering Law Applied to Highway Drainage, by R. Robinson Rowe. (HW) Applications of engineering law to highway drainage are exemplified after introductory definitions of legal terminology.

2275. Passenger Data for Urban Transportation Planning, by Nathan Cherniack. (HW) Freight and passenger movements in urban areas and difficulties of integration in solving urban transport problems are examined.

2276. Factual Data for Urban Transportation Planning, by R. R. Bartelsmeyer. (HW) This paper outlines the information that is needed to guide the thinking and planning for future transportation systems.

2277. Spacing and Interchange on Freeways in Urban Areas, by Jack E. Leisch. (HW) Bases for spacing of interchanges, including schemes for increasing operational efficiency, are presented.

2278. Modern Curvilinear Highway Location and Design, by Frederick W. Cron. (HW) Good highway locations and the satisfactory appearance of highways are reviewed.

2279. Glossary of Electronic Computer Terminology: Progress Report of the Committee on Increasing Highway Engineering Productivity of the Highway Division. (HW) The glossary covers approximately 350 commonly used terms and provides a working knowledge of computer terminology both for the engineer and for those requiring a more general understanding of the terms.

2280. Use of Mathematical Models in Estimating Travel, by Alan M. Voorhees. (HW) On the bases of relationships developed from numerous O-D studies that have been conducted throughout the country, it is now feasible to estimate urban travel patterns by mathematical procedures.

2281. Artificial Recharge of Ground Water Reservoirs in California, by Raymond C. Richter and Robert Y. D. Chun. (IR) The paper outlines some of the present needs for practice of artificial recharging of ground water in California.

2282. This Problem of Water Rights, by Robert L. Smith. (IR) The paper reviews certain basic concepts involved in the development of a "water rights" law.

2283. Legal Aspects of Ground Water Utilization, by Robert O. Thomas. (IR) An investigation of the historical basis of water rights doctrines is followed by a presentation of some of the legal problem areas which may arise in planning future ground water operations.

2284. Evaluating Furrow and Corrugation Irrigation, by Dell G. Schockley. (IR) Described is a procedure for evaluating furrow or corrugation irrigation to determine how uniformly and efficiently water is being supplied for crop growth.

2285. The Lemolo No. 1 Rockfill Dam, by J. C. Boyle and W. R. Barrows. (PO) The paper describes a rockfill reinforced concrete deck dam built during 1953-1959 for the California Oregon Power Company.

2286. Quick Design of Air Vents for Power Intakes, by G. S. Sarkaria and O. S. Hom. (PO) For closed conduit systems without surge tanks, a common parameter is derived and correlated with vent diameter used in 35 hydroelectric installations.

2287. Power from Geothermal Steam at the Geyser Power Plant, by Albert W. Bruce and Ben C. Albritton. (PO) The area and history of the geysers in north-

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ern California is reviewed; the testing of steam well flow, non-condensable gases and corrosion is described.

2288. The Stratton Steam Electric Station, by C. H. Alban. (PO) Planning and construction of the first four units of the Ohio Edison Company's 700 megawatt Stratton Station scheduled for completion in 1962 will extend over a decade.

2289. Underground Power Stations in Italy, by Dante Finzi, Mario Mainardis and Carlo Semenza. (PO) The reasons for underground plants and statistical data on all of Italy's underground plants are presented.

2290. Containment of Nuclear Plants, by Richard N. Bergstrom. (PO) Present practices in design and construction of containment vessels are reviewed.

2291. Determination of Stress on Anchor Blocks, by M. R. Bouchayer. (PO) The use of a more accurate determination of operating forces and mathematical formulas results in a more economical system of anchor blocks.

2292. Compaction of Sands and Bearing Capacity of Piles, by G. G. Meyerhof. (SM) The compaction characteristics of sands under impact are analyzed.

2293. Undrained Strength of Compacted Clays after Soaking, by H. B. Seed and C. K. Chan. (SM) The influence of soil structure and such structure-determining factors as molding water content and method of compaction on the strength of compacted clays after soaking is described.

2294. A Review and Evaluation of Soil-Cement Pavements, by James K. Mitchell and Dean R. Freitag. (SM) The factors affecting the properties of soil-cement are reviewed.

2295. Pile Construction in Permafrost, by J. A. Pihlainen. (SM) General construction problems and practice in permafrost areas, notably Canada, are reviewed.

2296. Construction and Maintenance of Underseepage Control Measures, by W. J. Turnbull and C. I. Mansur. (SM) A summary of basic principles involved in the construction and maintenance of various underseepage control measures is presented.

2297. Type Features of the Ohio Shoreline of Lake Erie, by Howard J. Pincus. (WW) With the aid of aerial photographs, features of the Ohio section of Lake Erie's shoreline are examined.

2298. Deep-Draft Navigation on the Great Lakes, by Walter E. McDonald. (WW) This paper describes studies undertaken in the present program for deepening the Connecting Channels and harbors to serve adequately the modern bulk cargo vessel fleet on the Great Lakes.

2299. Methods of Correcting Wave Problems in Harbors, by Ernest F. Brater. (WW) The causes of and some of the cures for objectionable wave conditions in harbors are outlined.

2300. An Approach to the Study of Overseas Traffic Potentials, by Wilfred G. McLennan. (WW) This paper deals with the methodology for estimating traffic potentials of general cargo in the United States foreign trade.

2301. Natural By-Passing of Sand at Coastal Inlets, by Per Bruun and F. Gerritsen. (WW) This article investigates two ways of by-passing as a function of littoral drift and tidal flow characteristics of the inlet in question.

2302. Investigation of Bluff Recession Along Lake Erie, by Robert Chieruzzi and Robert F. Baker. (WW) A systematic approach to the analysis of bluff recession problems is presented.

2303. Port Structures in Long Beach Harbor, by Bob N. Hoffmaster, Cort T. Johnson and Charles L. Vickers, Jr. (WW) The port of Long Beach is guided by a long range master plan whose purpose is to provide an efficient and self-sustaining port which will meet the present and future needs of the surrounding area.

2304. Public Services on Controlled Access Highways, by C. W. Hartford. (HW) The article relates the services to the public on controlled access highways to urban, rural and toll road projects and divides the services reviewed into services of necessity and services of convenience.

2305. Lessons of Collapse of Vancouver 2nd Narrows Bridge, by A. Hrennikoff. (ST) The author sees in this tragic occurrence not only a mere consequence of an error in design but also a manifestation of the effects of some factors not yet fully appreciated.

2306. San Diego Transportation Planning Studies, by Edward M. Hall. (CP) The concepts and administrative organization of this metropolitan area transportation study are described.

2307. Coordinating Public Works and Urban Renewal in Kansas City, Kansas, by Eldrige H. Lovelace and Ramon Duran. (CP) A useful and effective means to coordinate the timing and location of public works with urban renewal programs is delineated.

2308. Cut-Off Points for Cover Plates, by Nat T. Kanarek. (ST) A method is presented which results in a chart from which the theoretical cut-off point can be determined with sufficient accuracy.

2309. An Engineering View of Public Transit, by John C. Kohl. (CP) This paper, intended to stimulate discussion rather than to present formal conclusions, describes five divergent views of public transit.

2310. The Vortex Chamber as an Automatic Flow-Control Device, by R. C. Kolf and P. B. Zielinski. (HY) This paper presents a rational explanation of the resulting coefficient variation from dynamic similarity.

2311. The Settling Properties of Suspensions, by Ronald T. McLaughlin. (HY) The results of an analytical and experimental investigation of the settling properties of suspensions of particles in fluid are presented.

2312. An Unusual Deposit in a Hydraulic Tunnel, by Arthur Lewis Pollard and Hazen Etnier House. (PO) This paper describes chemical and bacteriological investigations to determine means of reducing the head loss.

2313. Simplified Procedure for Stress Analysis of Gravity Dams, by R. S. Sandhu. (PO) By applying the formula and tables derived in this paper a quicker solution of the "Principal Stresses", by the Gravity Analysis Method, can be calculated for a gravity masonry dam.

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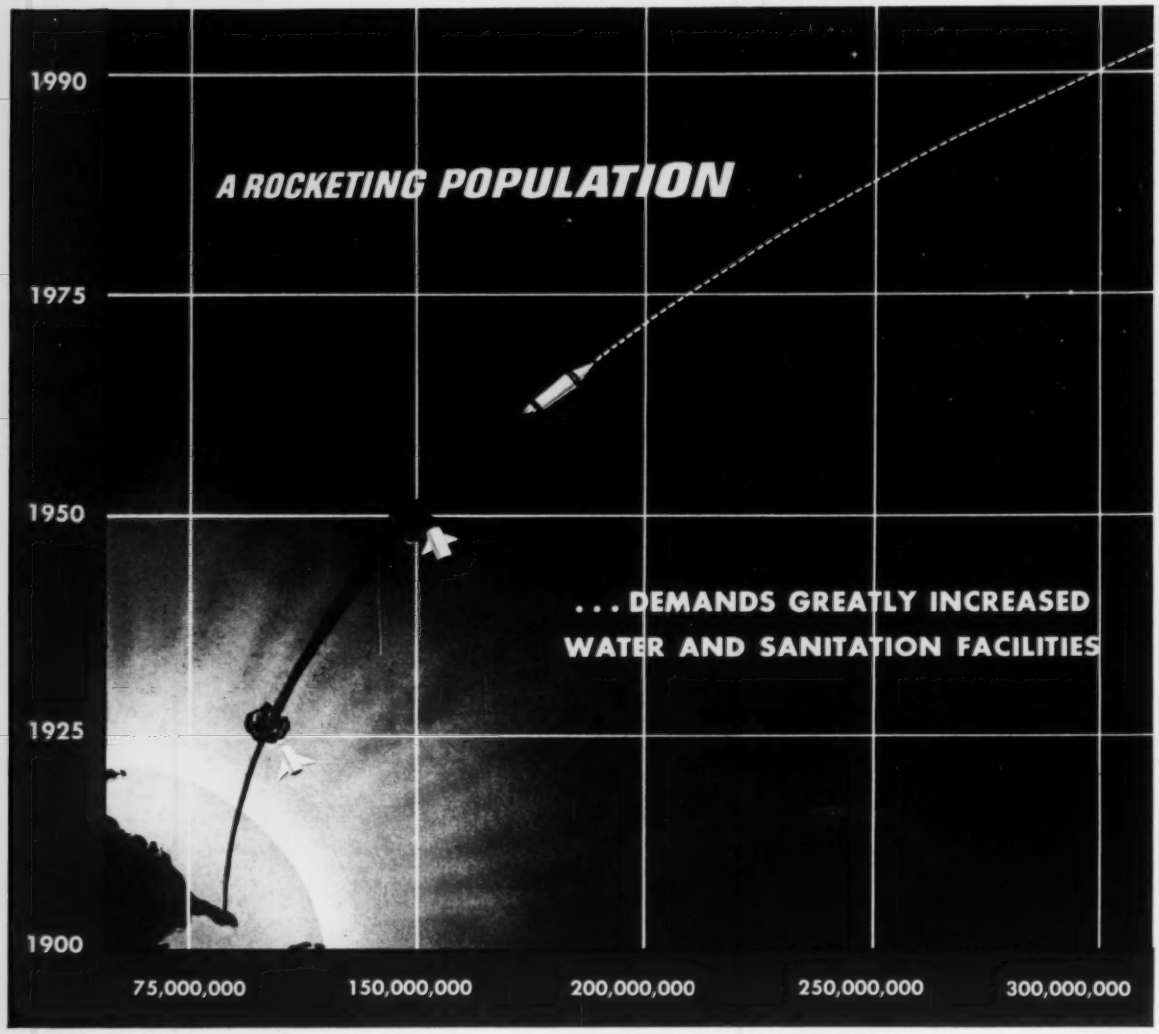

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